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BALTIMORE PAVES WIDEST STREET WITH BRICK

Cross Section Designed as Vertical Curve

By VICTOR J. BROWN
Publishing Director, Roads and Streets.

WHEN Works Progress Administration funds became available for labor relief projects, the city of Baltimore, Md., saw therein an opportunity to resurface some worn out streets. The engineering department of the Bureau of Highways of the Department of Public Works had plans already prepared for construction of many projects pending the day on which funds would become available for construction. Among those projects was street paving construction and reconstruction.

Brick paving offered an avenue of labor employment which would fit in with the regulations prescribed. Table I gives some detail of these projects as completed.

Some of the paving work was done by the Maintenance Division of the Department of Public Works and some was done by the Construction Division. The writer rode over most of the projects and can state that they are good looking, smooth riding jobs. Taxi drivers praise their non-skid surfaces. The natural color of the brick is preserved. On one job, a block long, expansion joints in the base was felt during riding.

It is the purpose of this article to discuss the construction of one of the brick street paving projects which is believed to be the widest brick paved street in the country. As shown by the accompanying plan view this street, called the Fifth Regiment Armory Plaza, is 190 ft. wide and 373 ft. long. The original street was lined on both sides with old houses which were acquired by the city and wrecked. The whole area was graded to a contour conforming with the general slope of the hill or knoll on which the Armory rests.

The general design of the plaza called for wide parking areas on either side of a normal traveled street width. For the protection of parked vehicles the entrances to the plaza were made to conform with the width of the continuing street to the north and a 60 ft. opening adopted for the south end. The armory is across the east and west street into which the 60-ft. plaza entrance opens.

General Design

All work, grading, pouring of the base, laying the cushion and finishing with a brick surface, was done by WPA labor supervised by the Maintenance Division of the city.

The accompanying plan and cross section shows the design. The main part of the plaza was built to a uniform cross section. Transition sections were required at the entrances as shown by the drawings. From subgrade up, the job is built of a 6 in. unreinforced concrete base, an inch or less mastic cushion, and 3 in. vertical fibre lug brick filled with a blown asphalt brick filler, in conformance with the standard specifications of the American Society of Municipal Engineers.

Because of the size of the area the base was laid in strips of varying widths. Between the slab strips premoulded asphalt expansion joints were placed when the slab was poured. Transverse asphalt expansion joints were also placed in the strips at the end of each pouring period.

The chief engineer for the Eastern Region, National

Droppers Lay Brick on Even Lines.

W.P.A. BRICK PAVING PROJECTS COMPLETED

Work Handled by the Construction Division

Street	*From*	*To*	*Yardage Sq. Yds.*	*BASE Type*	*BASE Thickness In.*	*CUSHION Type*	*CUSHION Thickness In.*	*Completed*
Barney St.	Covington St.	Webster St.	3,000	Concrete	7	Sand	1	Oct. 16, 1936
Bath St.	Calvert St.	Front St.	4,060	Concrete	7	Sand	1	May 8, 1936
Esther Pl.	East Ave.	Clinton St.	1,500	Concrete	7	Sand	1	Apr. 13, 1936
McCulloh St.	Eutaw St.	Lafayette Ave.	12,400	Concrete	7	Mastic	1	July 31, 1936
Russell St.	Bush St.	Stockholm St.	9,070	Concrete	7	Mastic	1	Oct. 2, 1936
Highland Ave.	Baltimore St.	Bank St.	10,800	Old Concrete	6	Mastic	1	Mar. 13, 1937
Appleton St.	North Ave.	Presbury St.	2,800	Concrete	7	Mastic	1	Sept. 3, 1937
Ruxton Ave.	Baker St.	North Ave.	3,800	Concrete	7	Mastic	1	Sept. 9, 1937
Eaton St.	Eastern Ave.	Bank St.	1,650	Concrete	7	Mastic	1	Sept. 1, 1937
Lafayette Ave.	Fulton Ave.	Mt. Royal Ave.	32,200	Concrete	7	Mastic	1	Dec. 22, 1936
Robb St.	20th St.	N. to Dead End	1,800	Concrete	7	Mastic	1	July 23, 1937
Monument St.	Park Ave.	Howard St.	1,800	Concrete	7	Mastic	1	June 16, 1937
Lexington St.	Fulton Ave.	Pine St.	21,400	Concrete	7	Mastic	1	May 13, 1937
Pier 6			5,000					

Work Handled by the Maintenance Division

Newkirk St.	Fleet St.	Bank St.	1,660	Concrete (New)	6	Sand	1	Aug., 1936
Macon St.	Fleet St.	Bank St.	1,545	Concrete (New)	6	Sand	1	Sept., 1936
Lehigh St.	Portugal St.	Bank St.	482	Concrete (New)	6	Sand	1	August, 1936
Lehigh St.	Eastern Ave.	Fleet St.	818	Concrete (New)	6	Sand	1	July, 1936
Fleet St.	Oldham St.	Lehigh St.	2,690	Concrete (New)	6	Sand	1	July, 1936
Franklintown Rd.	Baltimore St.	Frederick Rd.	4,945	Concrete (Old)	6	Sand	1	Sept., 1936
Calvert St.	24th St.	26th St.	3,868	Concrete (Old)	6	Mastic	1	Dec., 1936
Madison St.	Gay St.	Greenmount Ave.	7,929**	Concrete (Old)	6	Mastic	1	Sept., 1936
*Central Ave.	Orleans St.	Monument St.	422	Concrete (Old)	6	Sand	1	October, 1936
Chestnut Ave.	33rd St.	36th St.—Also						
33rd St.	Chestnut Ave.	Keswick Rd.	6,784***	Concrete (Old)	6	Sand	1	March, 1936
Maryland Ave.	25th St.	29th St.	8,668	Concrete (Old)	6	Sand	1	June, 1936
Jefferson St.	Lakewood Ave.	Curley St.	4,052	Concrete (Old)	6	Mastic	1	Sept., 1936
Monument St.	Cathedral St.	Park Ave.	1,476	Concrete (Old)	6	Sand	1	October, 1936
Saratoga St.	Cathedral St.	Park Ave.	1,628	Concrete (Old)	6	Sand	1	October, 1936
*Warden St.	Eager St.	Truxton St.	134	Concrete (Old)	6	Sand	1	Sept., 1936
Highland Ave.	Philadelphia Rd.	Fayette St.	1,980	Concrete (Old)	6	Sand	1	Sept., 1936
Fifth Regiment Armory Plaza			6,942	Concrete (New)	6	Mastic	1	Nov., 1936
Conkling St.	Toone St.	O'Donnell St.	1,508	Concrete (New)	6	Sand	1	October, 1936
Lorraine Ave.	Barclay St.	Greenmount Ave.	1,343	Concrete (New)	6	Mastic	1	Dec., 1936
Whitridge Ave.	Barclay St.	Greenmount Ave.	1,350	Concrete (New)	6	Mastic	1	January, 1937
Streeper St.	Baltimore St.	Fayette St.	2,254	Concrete (New)	6	Sand	1	March, 1937

Bituminous filler was used on all these jobs.
*The above jobs were "patch jobs" not repaved in their entirety.
**4043 Sq. Yds. of this is new base, balance is old base.
***2048 Sq. Yds. of this is new base, balance is old base.

Striking off the Mastic Cushion. Note That Strips Are Placed Directly on Base.

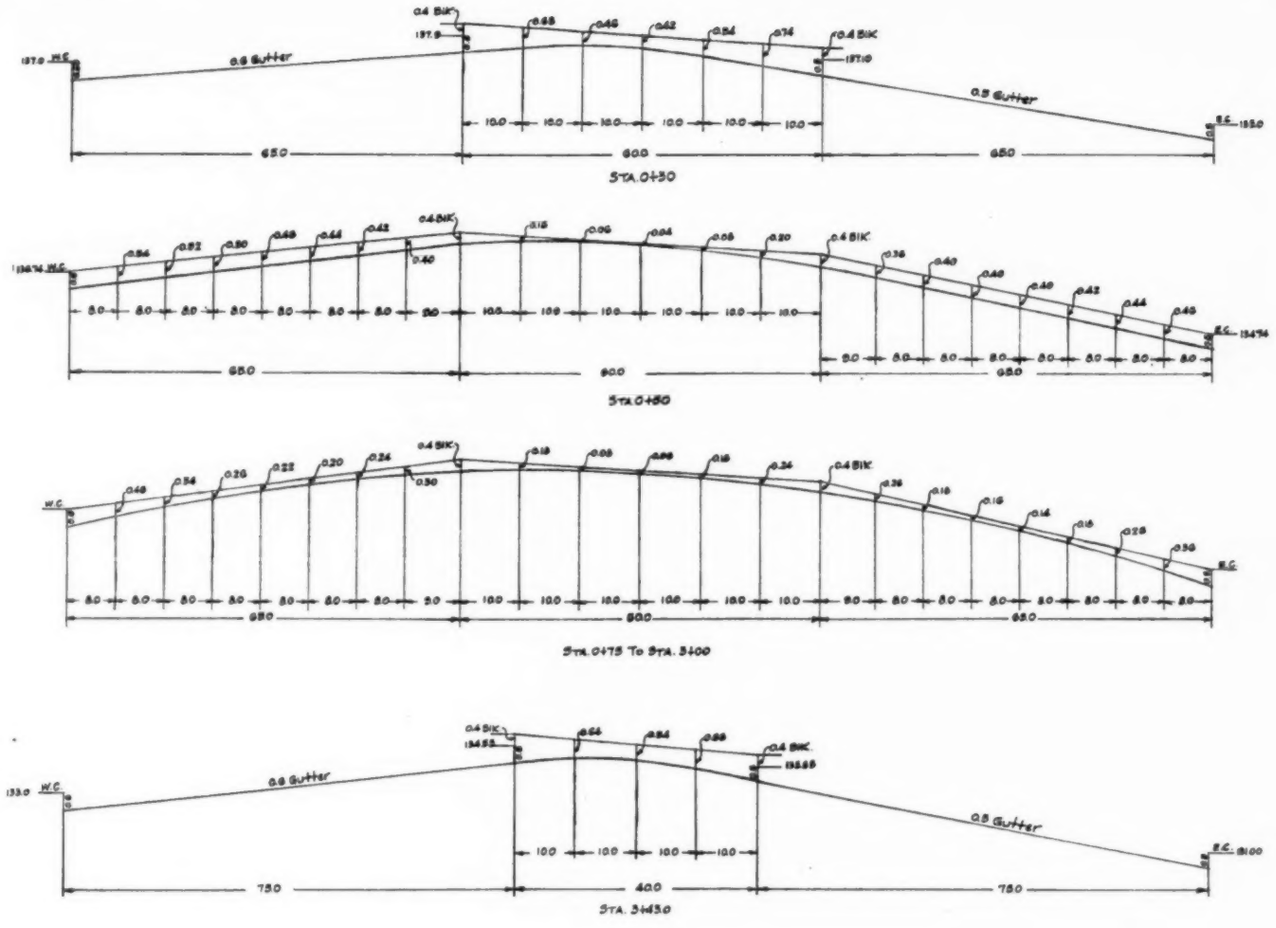
Paving Brick Association, Mr. Wm. C. Perkins, noticed this was done when the brick were being laid and had the joint material, in the remaining open joints, removed before the mastic cushion was placed. The joints were then filled with concrete. Recommended practice does not permit of installation of premoulded transverse expansion joints.

Mention is made of these expansion joints because at this time the bricks over those joints where the premoulded sandwich was not removed have been displaced upward so that all joints can be readily located. It is not my intention to state that displacement was caused primarily by those joints, merely to point out the fact that displacement of the brick has occurred directly over them.

Following is a table of quantities involved:

The curb on the east side is 2 ft. lower than the west curb. In designing the cross section of the brick surface, a six tenths (0.6) of a foot exposure was allowed on the curb face. From the high side of the street a 3 percent grade was laid across the street. From the bottom of the exposure on the low side, a 4 percent grade line was plotted to intersect the 3 percent grade line. Below this a vertical curve was drawn to represent the surface of the

How Brick Were Straightened into Even Lines.



Cross Sections of Improvement
5TH Regiment Armory Plaza

TABLE OF QUANTITIES FOR PAVING FIFTH REGIMENT ARMORY PLAZA BOLTON ST. FROM HOFFMAN TO DOLPHIN STREETS

	Area	*Type*	*Man Hours*
Vitrified Brick Paving (on mastic cushion)	6942.00 Sq. Yd.	3 x 4 x 8½ in. 235,904	5957
Concrete Base	6942.00 Sq. Yd.	6 in.	6424
Concrete Curb	1503.00 Lin. Ft.	6 in. x 20 in.	2981
Cement Concrete Footway	12255.00 Sq. ft.	4" Base 1" Toping	3874
Grading	7773.00 Cu. Yd.		9834

Started Nov. 12, 1935 Completed Nov. 4, 1936

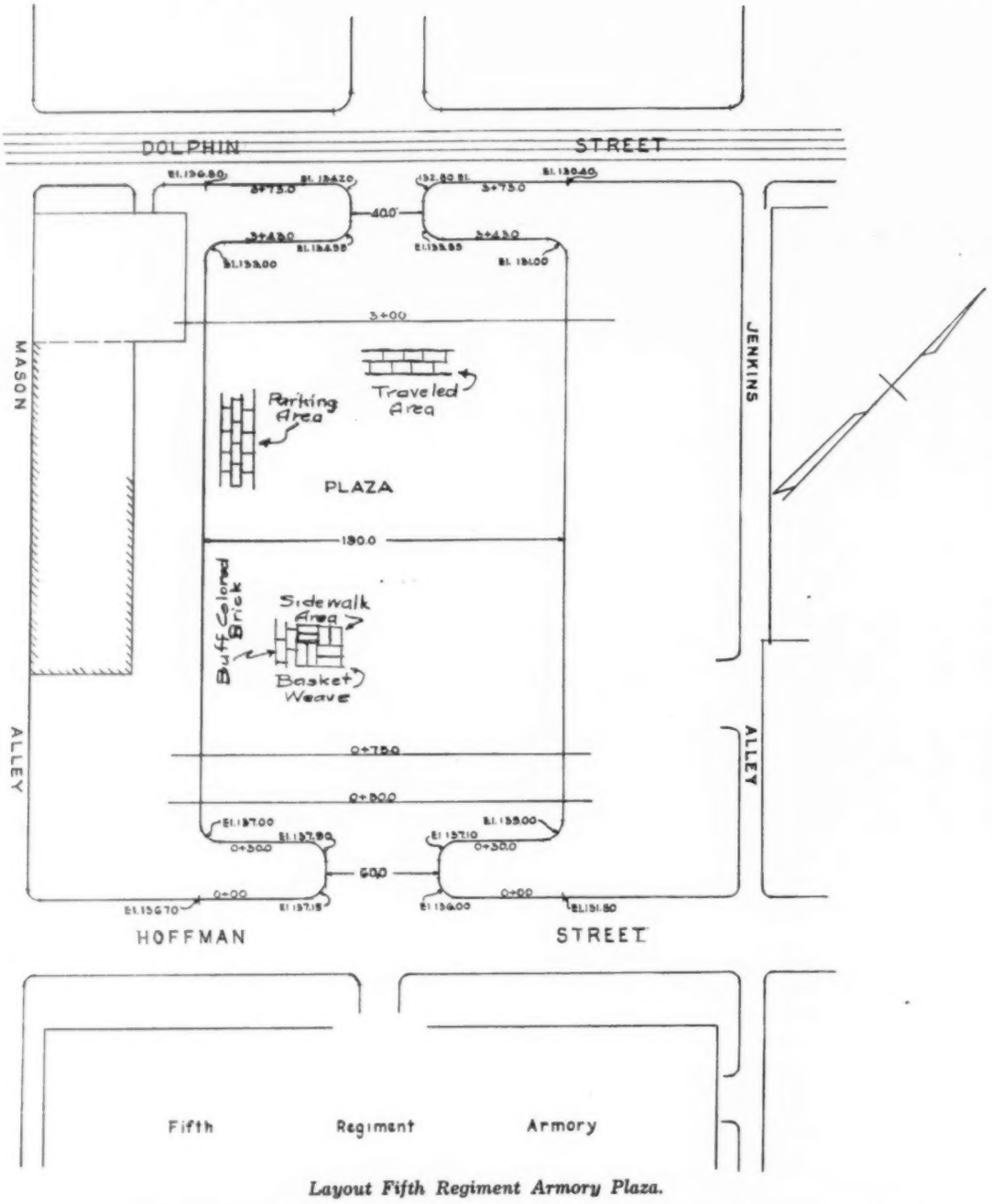
brick in cross section. The high point of the crown is below the intersection of the grade lines. Naturally, transition sections were required at each end to conform with the entrance cross sections. This design procedure results in an off-center crown which presents a pleasing appearance on the ground, and guarantees good drainage at all points.

The straight lines above the cross sections shown herewith are string line positions used for construction. The figures between the surface cross section and the string lines, indicate the distance to measure downward from the string line by which to locate the surface cross section during construction. The abbreviation "blk" means that a block was placed there over which to draw the string.

Construction Procedure

Typical brick paving construction procedure was followed except that brick were carried to the droppers rather than to use roll conveyors. To keep the lines of brick straight, transit lines from south to north were run at 5 ft. intervals. Marks were made on the base on each transit line and the droppers were required to check on each line.

Condemned Brick Are Removed



Layout Fifth Regiment Armory Plaza.

In the parking area portion, the brick were laid longitudinally, i.e., parallel to the east and west curbs. They were carried out to the sidewalk line where two double rows of buff brick were laid longitudinally to mark off the sidewalk. On the traveled way proper the brick were laid transversely as in usual practice. Here also, lines 5 ft. apart were drawn on the base to guide the droppers so they could get straight lines across the surface. On the 5-ft. sidewalk sections, between the two double rows of buff brick, a basket weave pattern was laid. These varying designs break up the area and present a more sightly appearance than if all brick had been laid transversely.

Typical Section Through Street, Fifth Regiment Armory Plaza.

Guide strips were placed on the base as strikeoff guides for the mastic cushion. The mastic was made by mixing 5 percent by volume asphalt cut back with sand.

After the brick were dropped a man followed with a spading hoe and made each line perfectly straight. They were rolled with a 5-ton tandem roller, culled, and the filler applied. In rolling, the roller travelled the long way of each brick. Since this job was completed, the standard specifications now define an alternate method which has proved more satisfactory. In this method plank of equal thickness are required to be placed on the surface and

View Showing Method of Tamping in Gutters.

B. L. Crozier, Chief Engineer, Dept. of Public Works.

rolling with a heavier roller, 5 to 10 tons, is done on top of the plank. This procedure gets a better bedding into the mastic cushion, prevents rocking of individual bricks and reduces cracking a great amount. Along the gutter lines the brick are hand tamped, the tamper dropping on top of a thick short board which lies directly on the brick.

On this job asphalt filler meeting the specifications of the American Society of Municipal Engineers was poured from buckets because of the small kettle employed. Paving brick association engineers recommend the use of a 500 gal. kettle and employment of two wheel concrete buggies for pouring the filler.

Removing Surplus Asphalt Filler Leaving a Clean Brick Surface. This Is Picture Taken on Another Street to Show Method Employed.

Prior to the filler pouring, the surface of the brick were painted with Brickote, a liquid which makes removal of excess filler feasible and easy. In removing the excess filler a particular technique has been developed. It is recommended that the filler remain on the brick for 2 or more hours before removal starts. Two men with spading hoes work side by side and with only cutting strokes they sever the joint filler from that excess which is on the surface. Care is taken not to pry upward, thus preventing pulling the filler out from between the brick. A man works with the cutters rolling the excess into a loose roll. He is cautioned to leave 6 in. or so unrolled at all times, thus preventing him from pulling up on the filler between the brick.

No further work is required and the resulting job is very smooth and non-skid, and leaves the natural color of the brick exposed. At the present time, on the Armory Plaza job, on the places where traffic does not roll regularly the filler is extruding slightly. On the traveled portion, this extrusion is kept ironed out.

Charles Foard, Ass't Highways Engineer, Bureau of Highways, Department of Public Works.

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Publication on Highway Bridges Available

"Highway Bridge Surveys," a booklet which describes with clarity and in complete detail the importance of the various kinds of data needed in the design of bridges, is being reprinted by the Federal Superintendent of Documents and will soon be available. Written by Mr. C. B. McCullough, an outstanding authority on bridges, this 76-page booklet was first issued several years ago. Published as United States Department of Agriculture Technical Bulletin No. 55, "Highway Bridge Surveys" may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., at 20 cents per copy.

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EXTRA LANE HIGHWAYS.—There are now in the United States 8,007 miles of Highway having a greater width than—2-lane surface. Of this total 4,704 miles are 3-lane; 3,082 miles, 4-lane; and 221 miles, 6-lane.

Annual Income of Engineers, 1929 to 1931

REPORTS from 52,589 professional engineers to the U. S. Bureau of Labor Statistics, in its survey of the engineering profession, undertaken at the request of the American Engineering Council, makes it possible to relate the income data to many aspects of professional engineering activity. These income data are probably the most comprehensive ever presented in regard to a professional group. The 52,589 reports were received from the following classes of engineers:

	Graduate Engineers Number Reporting	Other Engineers Number Reporting
Chemical and ceramic	3,697	203
Civil, Agricultural and Architectural	16,114	4,712
Electrical	9,924	1,519
Mechanical and Industrial	11,643	2,500
Mining and Metallurgical	1,910	277
Totals	43,288	9,301

The following general findings based on analysis of the reports is taken from the August Monthly Labor Review of the U. S. Department of Agriculture:

In 1929, 50 percent of the 30,032 reporting engineers earned more than $3,412, and 50 percent earned less than that amount. Twenty-five percent earned more than $5,012, but only 10 percent had incomes in excess of $7,466 per annum. On the other hand, 25 and 10 percent of the engineers earned respectively less than $2,509 and $1,878 per year.

Comparison of the incomes for 1932 and 1934 with those reported for 1929 shows that from 1929 to 1934, the sharpest absolute declines occurred in the two higher income groups. Their percentage decreases were least, however, averaging 31.2 and 31.6 percent, whereas the middle values of income declined by 33 percent, and the two lower levels by 41.3 and 53.6 percent, respectively.

Almost two-thirds of these decreases in earned annual income occurred between 1929 and 1932. There were further decreases from 1932 to 1934.

Among the several professional classes, the divergences in earning capacities were most marked in the higher levels of income. Furthermore, the ranking of the profession on the basis of earnings opportunity was the same in the highest 10 and 25 percent only.

In 1929, without regard to the age distributions of the different classes 10 percent of the mining and metallurgical engineers earned more than $9,912 per year, chemical and ceramic engineers ranked second with 10 percent earning more than $9,103, and were followed in order by mechanical and industrial engineers ($8,508), electrical engineers ($7,185), and civil engineers ($6,507). At the upper 25 percent level, mining and metallurgical engineers reported earnings of $6,301 per year, and those of the other professional classes ranged from 4 percent lower for chemical and ceramic engineers to 28 percent lower for civil engineers. This order of professional classes was also maintained in 1932 and 1934.

In 1929, the earnings of the mining and metallurgical engineers were highest in the middle and two lower levels of income, while those of the electrical engineers were lowest. At these three levels, the earnings of the former were $4,010, $2,839, and $1,985; for the latter they were $3,277, $2,339, and $1,662. Over these three levels, the relative positions of the three remaining professional classes changed. There were further shifts in 1932 and 1934.

The data also show that, over the period 1929 to 1934, relatively the smallest shrinkages in earnings were reported by the civil engineers, while the chemical and ceramic engineers suffered the greatest cuts. Over the five income levels, the former ranged from 29.0 to 47.2 percent, the latter from 35.6 to 63.8 percent.

Analysis of the income data reported by all engineers in 1929, 1932, and 1934 shows that earnings advanced with age in three distinct phases, showing initial periods of exceptionally rapid rise, followed by two others of slower rates of increase. The age spans of these phases varied with the income level.

With advancing age, the spread in earnings became most accentuated beyond the age of 38. Thus, at the ages of 44 and 60, the incomes of the upper 25 percent differed from the median or middle value by 41.0 and 51.0 percent. The corresponding incomes of the upper 10 percent at these ages were greater than the median by 116.0 and 157.0 percent. Even in 1932 and 1934, this advantage in earning capacity was maintained.

The earnings of the engineers in the lower income levels ceased to increase at a relatively early age. These showed a level period before beginning to decline, whereas the higher levels of income showed continuous increases for a considerably longer period, after which, however, they declined at a much greater rate.

Over the period 1929 to 1934, a rise in earnings occurred for the youngest engineers who were in the profession in 1929 and who were 30 years of age or less in 1934. Thereafter there were progressively larger declines for the older engineers.

Comparison of the earnings of engineers of identical ages in 1929 and 1934 shows that the average income of engineers who had been out of college for 2 years declined 43 percent. The income of those who had been out 5 years declined 35 percent. For older engineers the decline approximated 30 percent.

Consideration of the incomes reported by engineers of different educational backgrounds shows that those with a formal engineering education did receive a higher income. The differentials in earnings, however, did not accrue in equal measure for all five professional classes.

At about 28 years of age the "other" engineers had lost an initial advantage in earning capacity. At that point, the 1929 earnings of the graduates ranged from $2,725 to $3,000 per year, and those of the corresponding "other" engineers from $2,430 to $2,650.

With advancing age, the spreads in earnings in favor of the graduates became very marked indeed. For example, at 5, 20, and 37 years after graduation, the earnings of first-degree mechanical and industrial engineers exceeded by $175, $925, and $1,322 per year those of the engineers of the same professional class whose college course was incomplete, and surpassed by $225, $1,160, and $1,815 per year those of engineers with a noncollegiate technical school education.

THE MANAGEMENT OF HIGHWAY GRADING

The Third of a Series of Articles Dealing with Its Economic Aspects

By J. L. HARRISON

Senior Highway Engineer, U. S. Bureau of Public Roads, Washington, D.C.

CHAPTER 3.—Some of the Details Which Influence the Production of Power Shovel and Elevating Grader Outfits as Used on Highway Construction.

IN previous articles various references have been made to the fact that ordinary grading operations involve (1) digging and loading (2) hauling and (3) disposal on the dump. Rock work also involves preliminary preparation of the material but as this can be and usually is handled as a wholly separate operation, though important, it requires no special consideration in this series of articles.

As to both power shovel and elevating grader outfits, these three operations are separately tooled which, of itself, would not be a matter of great moment were it not for the fact that in highway construction the haul distance changes both widely and frequently. The problem is not, then, one of tooling three successive and obviously interdependent operations satisfactorily to meet a single condition. Rather it is one of tooling on a basis that will produce the best results under the wide range of conditions which affect the tooling of the second operation in the series, that is the hauling. Nothing about this phase of the work is constant. The material to be dug varies and these variations affect the rate at which the hauling units are loaded as well as the amount they will be called on to carry. The haul distance varies which, necessarily, affects the time required in hauling the load. Even the conditions on the dump vary with the result that the time spent in disposing of a load varies.

Fundamental Considerations That Must Be Observed

This recital of the varying conditions under which hauling must be done would be pointless were it not for the fact that production must be maintained in the face of these very conditions and that all of them must be taken into account in tooling the job and in managing it after it is tooled. This recital also is important as tending to show that there is no such thing as the perfect tooling of a power shovel or an elevating grader job. The tooling can be good, fair or bad, but to say, in any case, that it is perfect is impossible. The facts at the disposal of contractors and of engineers are not sufficient to warrant a conclusion as definite and as exact as this. Rather, the facts and the deductions it is proper to make from them, lead only to conclusions on the basis of which relatively well balanced outfits can be made up, and relatively high production assured at a relatively low unit cost. Beyond this point no one can safely attempt to go for so many styles of equipment are available and so many conditions mut be met on the job, that the selection of the set-up that will certainly produce the best results is quite beyond the realm of our present knowledge. It should not, however, be assumed that because the best cannot be certainly determined, fundamental considerations can safely be ignored.

Quite on the contrary, successful operation depends on recognizing fundamental considerations and observing them. And of these fundamental considerations perhaps the most important is that where production involves a series of successive interdependent mechanized operations or processes, all of these operations or processes as far as that is possible, must be tooled to the same output capacity. If this is not done, inevitably the output capacity for the job as a whole is limited to the capacity of the under tooled process.

Where a power shovel is to be used the tooling of the job should ordinarily be based on its normal output capacity, job conditions being considered. Job conditions are an important factor here for they will affect the shovel's capacity for production which is a good deal greater in good common than it is in even well shot rock, and is more or less affected by any material it is difficult to handle.

Tooling is based on the shovel because the investment in it is relatively large. In the days of horse-drawn wagons it usually was greater than the amount invested in all of the other equipment used on the job. Today it is not, relatively, as great as this, for the mechanization of hauling has considerably increased the investment in the units used to handle this part of the work. However, as a very general rule the investment in the shovel still is relatively so large that maintaining the highest practical utilization of the whole outfit quite definitely depends on keeping the shovel busy.

To illustrate, if the shovel is worth $15,000 and the trucks used on the job are worth $3,000 each, when the shovel stops working as much working capital is idle as when five trucks are doing nothing. While this illustration is accurate as far as the invested capital is concerned, the relative cost of operating the shovel as compared with the relative cost of operating the trucks somewhat alters the situation. Still, as a rough working rule the thought that a contractor can as well afford to have its value in hauling equipment idle as to have the shovel idle is worth remembering. The ideal situation is to have neither the shovel nor the trucks idle, but if one or the other must

be idle, it is a good deal better to have one or two trucks idle than to have the shovel constantly working at under-capacity.

Where an elevating grader is to be used for digging and loading, tooling usually should not today rest on a determination of its probable output capacity. This is because the cost of the tractor-elevating grader combination, which is the digging and loading tool, is about the same as the cost of the tractor-large wagon combinations quite generally used with it. The operating cost for the tractor-elevating grader combination is a little greater than the operating cost of a tractor-drawn wagon but not enough so to warrant special emphasis on keeping it busy. In other words having the grader idle is of little more importance than having one of the wagons idle which, in practice, means that in determining the amount of handling equipment to send to the job, the best average utilization of the hauling equipment usually should govern.

Tooling of Power Shovel Job

Returning to the consideration of the tooling of a power shovel job, and assuming that an estimate has been made of the average production that is to be maintained, the matter of getting this production to the dump must be solved. As already noted the time of the shovel must be definitely protected. Still, with a varying haul distance and with changing road conditions, it must be admitted that normally it is impractical fully to protect it. However, some rather simple calculations are possible which will help toward avoiding lost shovel time. These are discussed in the paragraphs that follow.

In the first place a good shovel runner can take out three dipper loads a minute. If his output is less than this, usually it is because the hauling operation is under-tooled. Very recently the writer looked over a large grading job which offers a typical example. At the shovel, four trucks were given two dipperfuls each and three tractor-drawn wagons were given four dipperfuls each—twenty dipperfuls in a shade under seven minutes, or about 21 seconds per dipperful. This was good as far as it went—but there it stopped! There wasn't any more equipment to load until one of the trucks got back some three or four minutes later! This is a very common condition on grading jobs. In fact, of the several hundred such jobs the writer has seen during the past 20 years, the great majority have been inadequately equipped to handle the hauling end of the work. No adequate explanation of this fact has ever been found unless it is that the sales promotion of such units as shovels, graders, etc., has outrun sales promotion in the perhaps more prosaic field of hauling equipment. Be that as it may, the fact remains that the average grading outfit is under-equipped on the hauling side of the work and that the addition of a few hauling units, if properly used, would reduce production cost.

An Example of Under-Tooling

In occasional instances the under-tooling of the hauling side of grading work has been found to be very pronounced. Some years ago the writer looked over a shovel job on which a ¾ yard shovel was in use. Production was low and costs correspondingly high, largely because the number of hauling units was definitely inadequate. To improve his cost of production, the contractor purchased a new 1¼ yard machine which, under ordinary operating conditions, can turn out just about twice the yardage a ¾ yard machine will produce. But costs did not drop as the contractor had expected. Upon inquiry it developed that no change had been made in the amount of hauling equipment in use. Such hauling equipment as was in use had been working and continued to work at capacity. The old shovel had been working at from 50 per cent to 70 per cent of capacity. The new one was working at from 25 per cent to 35 per cent of capacity. On that job at least two-thirds of the total investment in equipment was in the shovel. This two-thirds of the investment in equipment was then working at an average of only 30 per cent of its capacity. This is not the road to profitable operation.

Reverting to the fact that a shovel in good hands will produce 3 dipperfuls a minute it follows as a matter of course that it will produce at this rate only when it has a place to put material at this rate—that is hauling units to load. To maintain full production, the shovel must then be provided with hauling units at a corresponding rate. In other words, the number of hauling units that must be presented at the shovel every hour is 3x60 or 180 divided by whatever number of dipperfuls the hauling units are to be given. If each unit takes 3 dipperfuls, 60 hauling units an hour, that is a hauling unit every minute, are required. If each unit takes 4 dipperfuls, 45 units must be presented every hour. If large hauling units, say units that will take 10 dipperfuls are to be used, they must be available at the shovel at the rate of 18 per hour or one every 3⅓ minutes.

Effect of Length of Haul

Now, as the haul distance will change rather frequently and over rather a wide range, it evidently will be quite impossible to maintain a constant rate of output at the shovel, and at the same time to keep the hauling units which are in active use, effectively employed, unless the number of hauling units at work on the job is varied with variations in the haul distance. When drivers are easy to get, this is not an unsurmountable problem, but when labor is scarce and must be kept at work to be retained, the problem that is encountered at this point may be a serious one. The modern fully mechanized job does not provide many odd jobs at which surplus drivers can profitably be kept busy when the units they usually drive are not needed. In short they cannot be freely hired and laid off as job conditions would suggest is desirable. Because of this situation it has become the custom to work some given number of hauling units—usually the number that will keep the shovel busy at a length of haul that is about average for the job—and to send all of these units out to the job every day without regard to the haul distance at the moment prevailing. The result is a high percentage of under-production at the shovel when the haul is long—and a high percentage of under-utilization of the hauling units when the haul is short. This statement is equally applicable in regard to elevating grader outfits which usually are operated in this same way. As the under-utilization of equipment always involves expense it is desirable to avoid this. Anything that results in a better average utilization of the equipment is likely to prove profitable. Layer dumping offers a case in point.

Layer Dumping and End Dumping

In most states it is now required that fills be laid down in layers. This method of construction offers some very definite advantages as compared with the old system of end dumping. Where end dumping was permitted the haul distance increased progressively as the cut was taken out and the fill was extended. This necessarily meant that the haul distance increased rather gradually from a minimum of 100 feet or less to whatever maximum that particular balanced section involved. Layer dumping has radically changed this situation.

To illustrate, assume that in taking out cut No. 7, 350 feet of the cut must be moved east into a fill 1,000 feet long, of which 650 feet was to be built out of material from this cut. As an end dump operation the fill began (in theory) with a haul distance of 0 feet at the point the shovel entered the cut and gradually increased to 1,000 feet when the shovel had reached the balance point in the cut. This meant that to keep the shovel busy when it first entered the cut only two or three hauling units were required but that to keep it busy when the haul was 1,000 feet a large number were needed. When layer dumping is practiced, the fill is begun wherever most convenient—usually toward its far end—and the layers are brought up as convenience dictates. To keep all of the hauling units occupied it is then desirable to dump at several points along the fill. Now taking a fill which involves a minimum haul of 200 feet and a maximum haul of 1,000 feet, and assuming the contractor has enough hauling units to support shovel production up to 600 feet, if all of his units are working at some haul distance under 600 feet, they will all be working at under-capacity. If they are working at a point that involves a haul of over 600 feet the shovel will be working at under-capacity. But if, instead of working them all at one point part are kept, for instance, on a haul that is under 600 feet and part on a haul to this same fill that is over 600 feet, the average distance material is being hauled at any given time can be kept so nearly the same as the average haul distance the fill necessarily involves that a relatively high utilization of both shovel time and truck time is possible.

Number Hauling Units Should Be Calculated for Each Job

To obtain the best utilization of both shovel time and truck time, the number of hauling units to be sent to the work, should then, be calculated for each fill on the job, which in this day of layer dumped grading is not at all impractical. Moreover, as laying down a fill will take from several days to several weeks, the problem of hiring extra drivers for extra long average hauls, is much simplified. In short, with layer dumping, the hauling operation can be and should be kept in close balance with the digging and loading operation. For really profitable operation it must be.

As already noted, good production means about 3 dipperfuls loaded on the wagons every minute. This is true for practically all sizes and makes of power shovels used in highway construction. As a matter of fact, as far as the machines themselves are concerned, many of them can handle a dipperful every 15 seconds—4 dipperfuls a minute. However, very few operators can maintain this rate for long. In fact, any operator who can dig three dipperfuls an hour for day after day, even in good common, is much better than an average operator. In rock, even if well shot, the rate falls off a little, as does the load the dipper takes.

If production at the shovel is to be kept at 3 dipperfuls a minute—180 an hour—the number of trucks or tractor-drawn wagons that will be required will depend, in the first instance, on the size of the shovel, that is on the average load the dipper picks up, and on the rate at which it (the hauling unit) travels. In good common, the ¾ yard shovel will average about 0.45 cu. yd. per dipperful. This is the take as measured as excavation in original placement. The 1 yard machine takes about 0.65 cu. yd. The 1¼ cu. yd. machine about 0.9 cu. yd. The 2½ yard machine picks up a little more than 2 cu. yd. The pick-up varies a good deal with the material encountered. It varies, also, with the operator. The above figures are sufficiently accurate for estimating purposes—as useful indeed as even more exact averages would be—for inevitably production per dipper load varies so much from job to job, and even so much from day to day on the same job that greater accuracy in calculations such as those here involved would be quite valueless.

These figures call attention at once to one point that is important—that as the number of dipperfuls a shovel per hour in the hands of a good operator will produce is constanta the hauling capacity that is provided for a 1¼ yard machine must be about double that provided for a ¾ yard machine and that provided for a 2½ yard shovel should be somewhat more than twice as great as that provided for a 1¼ yard machine. A recognition of this situation is an essential in organization for profitable production.

Elements on Which Hauling Rate Depends

The rate at which the hauling units can be operated involves (1) the time required to get the hauling unit into place at the shovel, (2) the time required to put on a load, (3) the time required to haul it to the dump, (4) the time required to dump it at the fill and to turn around, and (5) the time required to return for the next load. One would like to be able to say that exactly so much time is required for each one of these elements in round trip time. This cannot be done, for job conditions vary a good deal and these variations interfere with the exact functioning of hauling equipment. Still, certain facts can be presented which are useful in making estimates and in checking job performance. These may be stated as follows:

The time a hauling unit requires to drop its load at the dump and to turn around should be the same for all units of a given style and, with good management at the dump, should remain constant day after day throughout the job. It will vary a little with the kind of unit involved. For instance, the modern heavy dump wagons drop their load very quickly—indeed without even stopping. On the other hand heavy dump trucks must stop while the hoisting mechanism is used to elevate the dump body. Some of these hoists are fast—others slow. The contractor should study these operations on his job and determine the time his units do consume in handling them. This it is easy to do, as the second hand on an ordinary watch will give readings quite accurate enough for all practical purposes. The time taken to dump and turn around on the fill, to get under the shovel, to take on a load, should be taken at frequent intervals, both for the purpose of collecting information as to what these constants are and for the

purpose of keeping check on whether they are being handled with proper dispatch on the going job.

The time spent in turning around and in taking on a load at the shovel should also be constant. The time used in dumping and turning around on the fill, plus the time used in turning around at the shovel and getting into position to take on the load there, should then be constant from load to load and should not take over a minute and a half but are more likely to take from two to two and a half minutes. Not infrequently the time spent in this way is even greater than this. If it is it should be carefully studied to determine whether time is being wasted by the men or whether the equipment or job conditions are at fault.

Add to the time spent on the dump and at the shovel, 1 minute for every 3 dipperfuls put onto the hauling and the ordinary working constant for these operations ranges from 3 (2+1) minutes for small trucks working under a ¾ yard shovel (or for large trucks working under a large shovel) to about 6 minutes for a large tractor-drawn wagon working under a ¾ yard shovel (about 3 minutes for the same unit under a 2½ yard shovel). This constant is the time spent during each round trip on something other than hauling and returning for the next load. It is, in effect, unavoidable, dead or unproductive time which, if a good profit is to be obtained, should be kept a minimum.

To the constant as described above it is necessary to add the hauling time—the time required in order to haul the load from the shovel to the dump and to return for the next load if the full round trip is to be known. The time required for this operation varies with the distance the load is hauled. On the job, tractors maintain a pretty constant working speed. Usually this is about 250 feet per minute.

Rules for Calculating Number of Hauling Units Required

Where tractor-drawn wagons or similar relatively constant speed hauling units are used, the calculation of round trip time and from it the number of hauling units to be used at any given time should be according to the following rules:

Assume *2 minutes for dumping, turning at the dump, and getting under the shovel. Add to this ⅓ minute for each dipper load customarily put on the hauling unit. This is the dead time (constant) each load should take in addition to the time spent in hauling a load and returning for the next.

To this dead time add 1 minute for each 125 feet of average haul distance to the fill on which work is to be done. This will give the average round trip time that should be maintained. If it is greater than this, time probably is being lost somewhere along the line and an effort should be made to find the loss and eliminate it.

The number of minutes in an hour—60—divided by the number of minutes required for a round trip, gives the average number of loads each hauling unit should take each hour.

The production of the shovel—180 dippers an hour in good common—divided by the number of dipper loads put on each hauling unit gives the number of hauling units the shovel needs each hour if it is to maintain full production.

*When records are available from the contractor's own work these should be used instead of the assumptions as stated here.

The number of hauling units the shovel needs each hour to maintain full production, divided by the number of loads each hauling unit should take each hour, gives the number of hauling units that are required on that fill to keep up production at the shovel.

As a rule, the "number of units that are required to keep up production" will come out as a whole number and a fraction, as 7-3/11 or 5-2/9, etc. Use the next whole number, as 8, 6, etc. When small trucks are to be used it often is good practice to add still another unit more fully to prevent delays at the shovel.

If trucks are to be used for hauling, the calculations as given above, require no alteration except as to the rate at which the trucks will travel. This is highly variable. When the roadway is in good condition rather high speeds can sometimes be maintained. When the roadway is poor, the speed at which the trucks can be operated is much reduced, speeds as low as 4 to 5 miles an hour being by no means uncommon. The effect of this situation is interesting in that it tends to invite tooling on some rather conservative basis for ordinary average conditions with a resort to higher speed to maintain production at the shovel when the haul is long. To illustrate, assume that the trucks in use will take four dipperfuls, that tooling is based on a working speed of about 6 miles an hour or say 500 feet of travel per minute, and that 700 feet is the ordinary haul distance. Average hauling time is, then, 2-4/5 minutes plus the usual constants—1 minute at the dump, 1 minute turning, etc., at the shovel, and 1⅓ minutes for loading, for convenience, say 6 minutes. Each truck should, then, make 10 round trips an hour.

The shovel should turn out 180 dipper loads an hour and to do this it must have 45 trucks an hour to load if it puts 4 dipper loads on each truck. As each truck should make 10 round trips, 4½ trucks are indicated which, in practice, means that 5 of these trucks are required.

Now this tooling is based on a travel speed of 6 miles an hour, which is a good deal less than the speed at which trucks will travel if road conditions are favorable. This tooling is good at 6 miles an hour for an average haul distance of 700 feet. If the speed is lifted to a little over 10 miles an hour, the constants are not changed. The trucks merely cover 900 feet a minute, while hauling, instead of 500 feet per minute, with the result that production is maintained up to an average haul distance of 1,260 feet.

Horses and wagons were constant speed units. Tractors, in practice, are constant speed units. Trucks are capable of a good deal of variation in operating speed. Their popularity as hauling units on shovel jobs is, to no small extent, based on this fact. It never is desirable to overdrive trucks any more than it is desirable to overload any other type of equipment. Still, the fact remains that trucks are built to provide a great deal of flexibility in the speed at which they travel and that contractors can and do take advantage of this flexibility. Which leads to one observation: The possibility of taking advantage of this flexibility depends almost entirely on road conditions. Heavily loaded trucks cannot be operated at other than low speed with any degree of safety unless the ground over which they are traveling is good. It therefore pays to give very definite attention to keeping the road over which the hauling must be done in the best possible condition. Always desirable, this becomes absolutely essential if long hauls are to be handled by speeding up the trucks.

WHAT ABOUT OUR OLD BRIDGES

Results of Oregon Studies of Effect of Heavy Motor Transport on Highway Bridge Stresses

By C. B. McCULLOUGH
Assistant State Highway Engineer, Salem, Ore.

I HAVE read with much interest the article in the August issue of ROADS AND STREETS entitled "What About Our Old Bridges," in which the California situation and practice are described.

Early in the current year this department undertook a similar investigation, and published the results of its findings as departmental Bulletin No. 6 under the title "The Effect of Heavy Motor Transport on Highway Bridge Stresses." It is significant that the results of the Oregon studies operated to isolate exactly the same type of trouble as indicated in the California investigations, namely, the somewhat alarming stress effects produced by heavy 2-axle and 3-axle concentrations at or near the midsection of typical vehicular trains. As illustrative of this point, Fig. 1 indicates the percentage of overstress produced by a type of vehicular train legally permissible on the Oregon highways, and also on the highways of many of the other states, as compared with the standard H-15 loading of the A.A.S.H.O. The percentage of overstress is indicated for typical reinforced concrete arch spans, steel truss spans, and girder spans, both in timber and metal. The loading diagram assumed as typical of what may be reasonably expected under present legal restrictions is indicated at the top of this figure. This loading is restricted by the formula $W=700(L+40)$ and a limited over-all length of 50 ft. A 3-axle truck inducing load concentrations equivalent to 75 per cent of the above vehicular maximum is assumed as following and preceding the principal vehicular unit. This load combination, as will be observed from a study of Fig. 1, operates to produce overstresses reaching a value of nearly 35 per cent in the case of stringers, about 32 per cent for reinforced concrete arch spans, and 30 per cent for steel trusses in shear.

Figure 2 indicates two modifications of the above loading: the first, which is designated as Case IV, limits the midsection axle loads to 37,500 lbs. within a limiting over-all distance of 20 ft.; the second modification, designated as Case V, limits these same midsection loads to 35,000 lbs.

Figure 3 is a graph of floor beam moments produced by these three cases of loading. On this same graph are in-

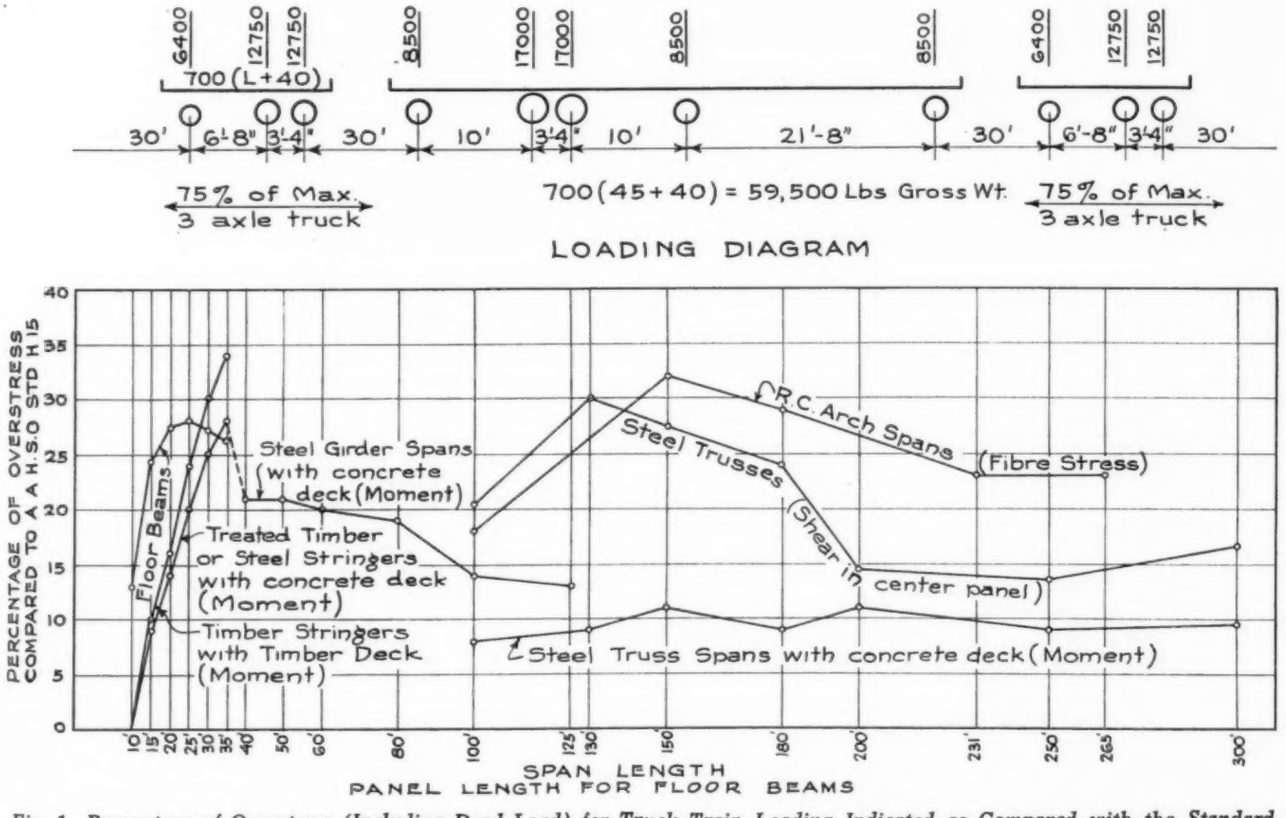

Fig. 1—Percentage of Overstress (Including Dead Load) for Truck-Train Loading Indicated as Compared with the Standard H-15 Loading of the A.A.S.H.O.

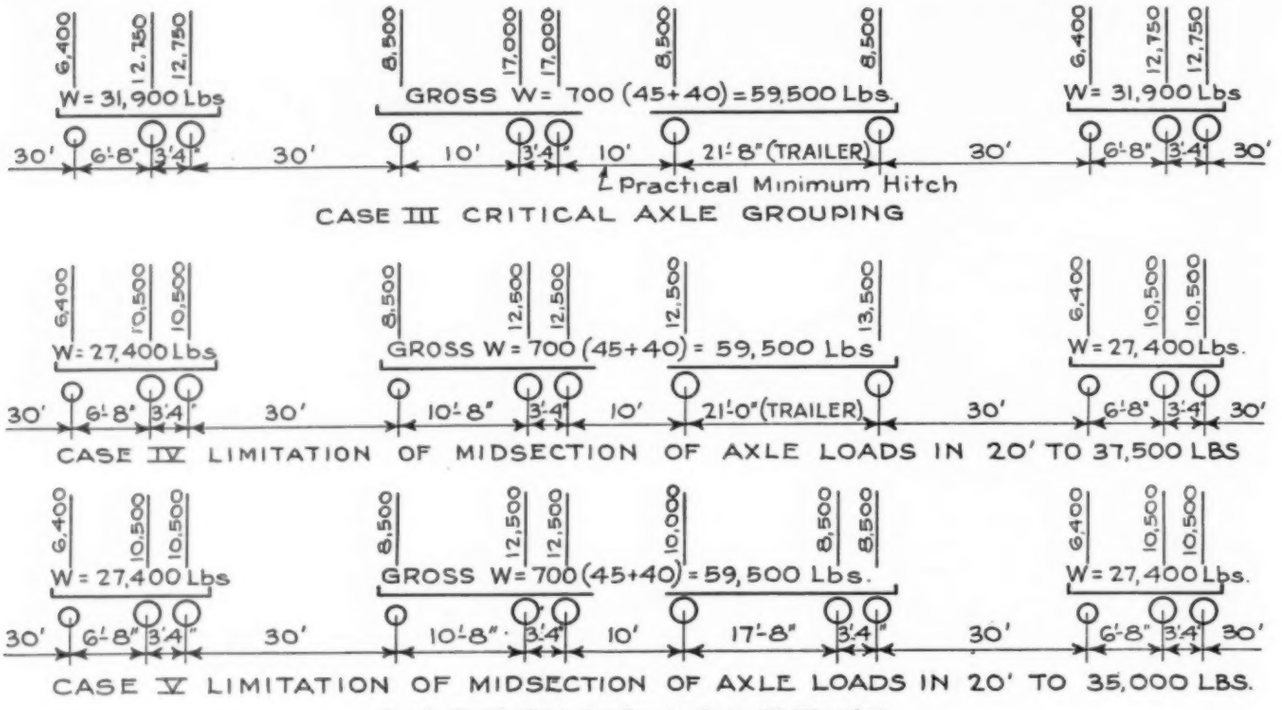

Fig. 2—Truck-Train Loading in Cases III, IV and V.

dicated analogous stresses produced by the present A.A.S. H.O. H-15 loading, and also this latter loading plus a 50 per cent overload. For convenient reference, a 10 per cent overstress condition is also indicated. A study of this figure indicates that the midsection axle limitations imposed by either Case IV or Case V operate to reduce all overstress to a value only slightly above 10 per cent, whereas the unrestricted vehicular train (Case III) produces overstresses in excess of 25 per cent.

Figure 3 has to do with floor beam moments only. Similar comparisons, however, were made for floor beam reactions, stringer moments and for stresses in trusses, girders and arch structures. The investigation was extended to include higher load intensity formulas and also longer vehicular train lengths, and as a result, the following conclusions were stated:

"Based upon the foregoing studies, the following conclusions and recommendations are submitted:

"1. In view of the interstate character of a large percentage of the heavy motor transport operating over the Nation's highway systems today, it is highly desirable that the regulations as to the limiting weights and dimensions of motor transport units adopted by the various states be uniform, particularly throughout any single trade area, such for example as the western states.

"2. The following restrictions and limitations are suggested as a basis for the enactment of uniform laws covering this portion of the traffic code:

"(a) That the total gross load comprising any vehicular unit or connected group of units shall not be greater than the value given by the formula $W=700(L+40)$ where W represents the total gross weight, and L=the distance between the first and last axles of the vehicular unit or connected group of units.

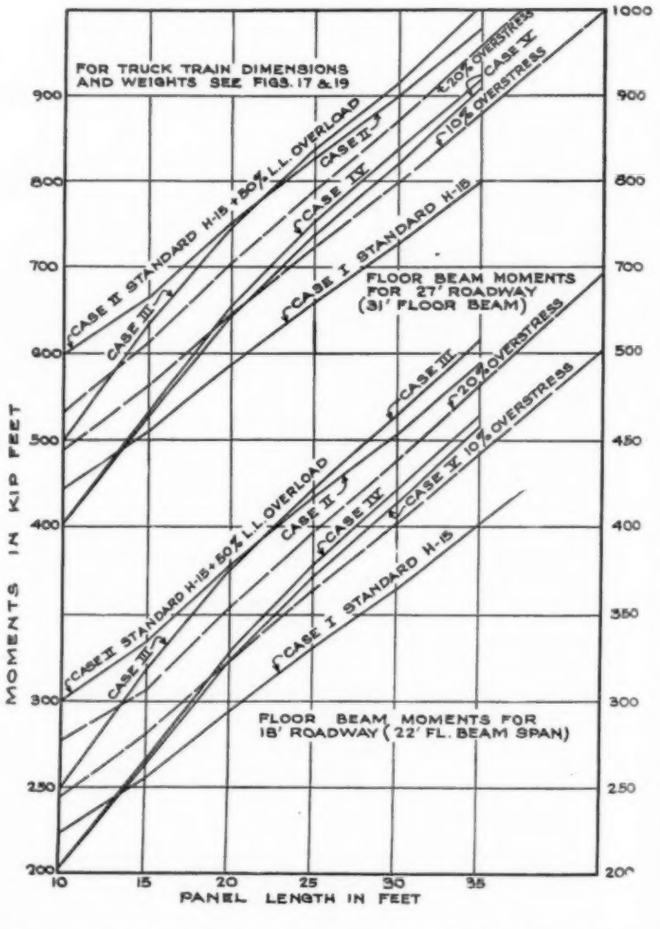

Fig. 3—Floor Beam Moments Produced by Loading Cases I, II, III, IV and V.

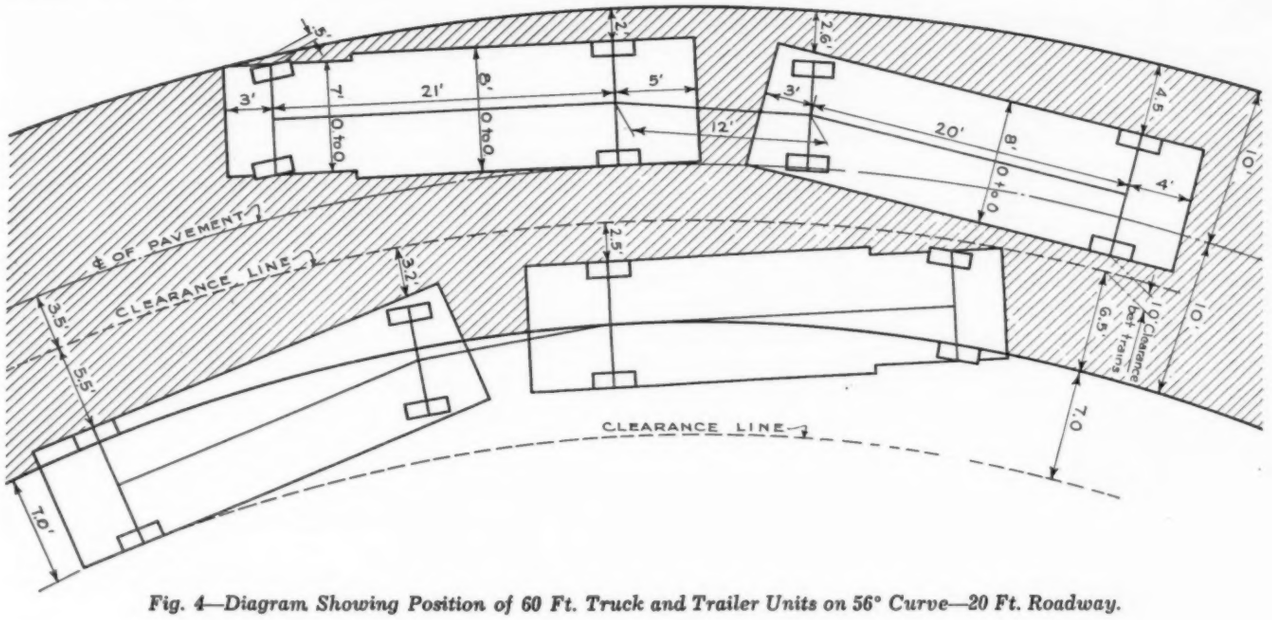

Fig. 4—Diagram Showing Position of 60 Ft. Truck and Trailer Units on 56° Curve—20 Ft. Roadway.

"(b) That the maximum weight concentrated on any group of two axles with a center to center spacing of six feet or less shall not exceed 28,000 pounds, or 14,000 pounds per axle.

"(c) That the maximum weight of any group of three or more axles concentrated within a horizontal distance of 20 feet or less, measured from center to center of outer axles, shall not exceed 35,000 pounds.

"3. The limiting over-all length for any vehicular unit or group is a matter which involves traffic movement and safety but does not appreciably affect resultant bridge stresses for values of "L" in the above formula not greater than 65 feet which corresponds roughly to a maximum over-all length limit of 70 feet. Any upper limit for over-all length less than 70 feet must therefore be determined by virtue of conditions affecting roadway widths, and ruling curvature on any particular highway or section of highway. An over-all limit of 50 feet (See Fig. 9 to 16) appears to constitute the maximum for pavement widths of 20 feet, and alignment conditions involving curves greater than 28 degrees. For better alignment conditions and wider roadways, over-all limits may be increased but it would appear, in view of the fact that the permissible safe maximum is a function of the particular characteristics of the individual highway or sections of highway considered, all vehicular units or connected groups of units in excess of 50 feet in over-all length, should be allowed on the highway only under *special permit*, and then only for *particular highways* or *sections of highway.*

"4. In addition to the foregoing limitations, a maximum limit should be placed upon the weight of any individual axle. This limit, however, is controlled by the resistance of the pavement, and, within the limits imposed by law, at the present time in effect in the majority of states (16,000 to 18,500 pounds), is not a controlling factor from the standpoint of highway bridge stresses.

"5. In view of the millions of dollars which are already invested in highway bridge structures throughout the nation, the above limitations as to vehicular weights are necessary and completely warranted. Even with the above restrictions, however, slight overstresses are induced by the passage of the heavier vehicular units or unit trains. For future construction, such a condition of overstress may be eliminated in large measure, and without mater-

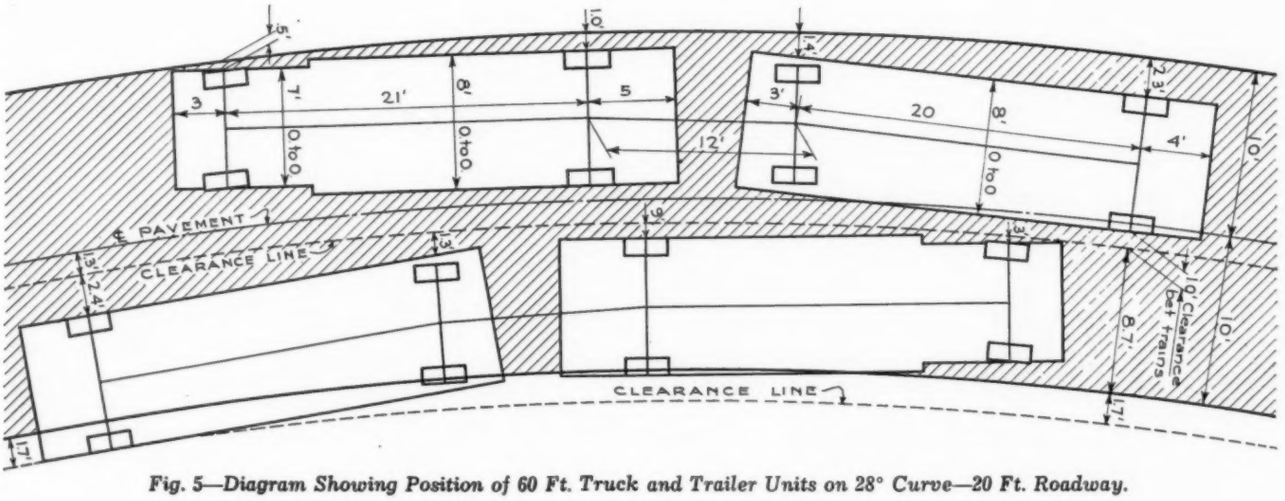

Fig. 5—Diagram Showing Position of 60 Ft. Truck and Trailer Units on 28° Curve—20 Ft. Roadway.

ially increased expense through the modification of the present standard loading specification by adding the following provision:

" 'Members of structural steel and of concrete shall be so proportioned that an increase of the highway live load of 50 per cent will not produce combined unit stresses in the members more than 20 per cent greater than those herein specified.'

"6. The above analyses and comparisons have all concerned themselves with bridge structures designed for the standard H-15 loading of the A.A.S.H.O. The heavy overstresses produced even in these modern structures point the necessity for a *careful examination* of all bridges on any state highway system designed for a lesser loading condition. Such structures should be *posted with load limit signs,* in all cases where the overstresses produced by the heaviest permissible vehicular units or unit trains are serious."

The midsection axle limitations hereinabove imposed are more rigid than those imposed by the California formula $W=2100(2N+L)$ discussed in the August issue of ROADS AND STREETS, and it would be the writer's opinion that the California limitations should be further restricted if overstress conditions are to be held below conservative established values.

The proposal has been made at various times that the standard formula $W=C(L+40)$ be extended to apply to each individual axle group. This restriction will result in a midsection limitation slightly less severe than that proposed as a result of the Oregon studies but more severe than the California limitation as described in your August issue. As an illustration, the midsection concentration proposed for any three-axle grouping contained in an over-all distance of 20 ft. will be 35,000 lbs., according to the Oregon recommendations. Applying the formula $700(L+40)$, this allowable maximum will be raised to 42,000 lbs., or an increase of 20 per cent. Applying the California formula, the allowable limit would amount to $2100(6+20)$, or 54,600 lbs.

The Oregon restriction is perhaps somewhat severe when applied to conditions in other states; however, after repeated conferences with owners and operators of heavy automotive equipment, we have come to the conclusion that the 35,000 lbs. midsection concentration limit can be met without undue embarrassment to existent shipping in and through this state.

In addition to the 50 ft. vehicular length, our investigations were extended to include over-all lengths up to 80 ft. It was found that the 80 ft. length operated to induce some rather high overstresses but that the 60 and 70 ft. lengths were not objectionable from a load standpoint if the 35,000 lb. midsection axle group limitations were imposed. These longer lengths, however, will doubtless be eliminated from consideration on account of alignment and traffic safety conditions.

Figures 4 and 5 indicate the position of a 60 ft. truck and trailer unit on a 20 ft. roadway for curvature conditions of 56° and 28°, respectively. It will observed that under neither of these conditions is it possible to keep the vehicular unit entirely on the pavement.

Candid Camera Shows Need for Ample Highway Width

The average motor vehicle driver wants plenty of clearance in passing other vehicles and there are few drivers that barely clear the passed vehicle. This is the conclusion of a candid cameraman of the U.S. Bureau of Public Roads who trailed motorists and made a motion picture record of their actions in passing other vehicles. The purpose was to throw more light on the width of highway necessary for the safety and convenience of modern traffic.

The camera was mounted upon a bracket just outside the driver's window; and a mechanical arrangement enabled him to operate it while driving. The pictures were later studied to determine what positions motor vehicles take on the road when passing other vehicles and when being passed.

The observers placed their car in free traffic, selected a vehicle and followed 200 to 300 ft. behind it, near enough to get a good picture but far enough to encourage a third vehicle to pull in between. Just as the middle vehicle pulled out to go around the leading one, the camera was started and the entire passing maneuver was photographed. The observers drove at the same speed as the vehicle being followed, and the speed was recorded. In addition, the place of passing was marked for examination and measurement of road conditions.

In this way, the observers could study the positions on the pavement of all kinds of vehicles passing in the same and opposite directions. Examples were taken on two-lane highways of 18, 20 and 22-ft. widths, surfaced with portland cement concrete or bituminous concrete, and the following observations resulted:

Motorists usually allow ample clearance when passing other vehicles. Both cars and trucks follow the centerlines of traffic lanes closely when being passed. The average clearance of passenger cars overtaking and passing other passenger cars ranges from 3.8 ft. on 18-ft. surfaces to 4.9 ft. on 22-ft. surfaces. For opposite-direction passing the range is from 4.0 ft. to 5.7 ft.

Speed has an effect on the car's position on the pavement. As the speed increases, drivers tend to travel farther away from the right edge of the road. A car passing another car going in the same direction requires more road width than one passing from the opposite direction, for it must travel faster than the car in front. On pavements only 18 ft. wide, the left wheels of the passing vehicle are often driven on the shoulder.

In general, it was found that roads 18 ft. wide are too narrow either for passenger cars alone or for mixed traffic; that pavements 20 ft. wide are inadequate for dense traffic involving trucks, but are reasonably satisfactory for the more lightly traveled roads with few trucks; and that a road width of 22 ft. is entirely adequate, safe and comfortable for modern mixed traffic.

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CONTRACT LET FOR 35-MILE COLONIZATION ROAD IN CANADA.—The Minister of Colonization, Quebec has awarded a contract for the construction of the first section of 35 miles of a road from St. Anne des Monts to New Richmond, Que., to Compagnie de Construction Colabrese, Limitee, 354 St. Catherine St., East, Montreal, Que.

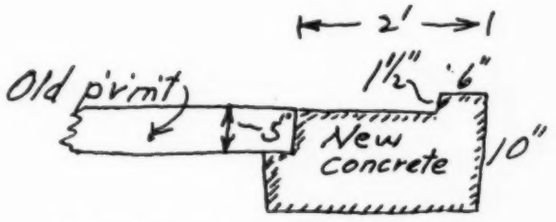
WIDENING AND RESURFACING 17-YEAR-OLD PAVEMENT

By JOHN E. BLAIR
Division Engineer, Texas State Highway Department

STATE Highway No. 20 across Washington County, Texas, was paved with concrete in 1920. At that time design standards were lower than would be considered acceptable now, and the highway is no longer satisfactory to carry the traffic which is offered. The grade has numerous summits where the sight distance is not more than about 200 ft., and the pavement was only 16 ft. wide. The alignment was reasonably good, so that no relocation was considered necessary except for short sections through the towns of Chapel Hill and Burton.

The Texas Highway Department began about four years ago to study means of widening and resurfacing this old pavement to meet modern traffic requirements, and as a result of several experimental sections constructed since that time the plan used in resurfacing the section from Brenham west to Burton was evolved. Briefly, the plan adopted was to widen the old pavement 2 feet on each side with concrete, and then to resurface the entire width with a mixture of crushed stone and cut-back asphalt. The old pavement was badly cracked and very rough, so that variations of several inches from a true surface were to be found within the space of a few feet.

Special study was given to the summits mentioned above, where sight distance was restricted. Many bad accidents had occurred at these summits due to collisions directly traceable to lack of sufficient sight distance. It was not considered advisable to try to cut down these summits because of the fact that this plan would involve closing the road to traffic for considerable periods, and no satisfactory detour was available. It was decided to widen the pavement at these places to a minimum of 30 ft., and by a special arrangement of center striping to make an effort to direct traffic in such a way as to minimize the chances of an accident of this kind.



Sketch Showing Pavement Widening Section.

Widening Old Pavement

The old pavement was widened a minimum of 2 ft. on each side with new concrete. The section used is shown in the sketch. A subgrade trench was excavated, the rough cut being made with a small gasoline excavator equipped with a skimmer scoop. Fine grading was done by hand. Steel forms were set on one side, the old pavement being used as the form on the other side. No means of attaching the new base to the old pavement was provided, it being assumed that dowel bars were not necessary. Con-

The Central Mixing Plant for Preparing New Wearing Surface.

2-Ft. Trench Section Ready for Concrete.

crete for this extra width was placed by two methods, first by mixing at a central mixing plant, hauling in trucks, and dumping into the subgrade trench, and second, by running a paving mixer on the roadway and discharging the mixed concrete directly into the trench. Both methods proved to be satisfactory, although the former method offered less interference to traffic. The concrete was screeded and finished by hand, and was cured with wet burlap. At the summits where the pavement was to be built 30 ft. wide, the new concrete was laid to a maximum width of 7 ft. on each side.

Preparing Asphaltic Mix

For making the asphaltic mix for the new wearing surface crushed stone sized to pass a ¾ in. screen and to be retained on a 20-mesh sieve was used. This stone was mixed cold in a central mixing plant with light rapid curing cut-back asphalt of a minimum asphaltic content of 60 per cent. As a matter of fact the asphalt used contained an average of about 62 per cent bitumen, and was warmed only enough to make it flow and mix readily. No artificial method of heating or drying the stone was used, and it was found that the stone and the asphalt mixed readily even when the aggregate was fairly damp.

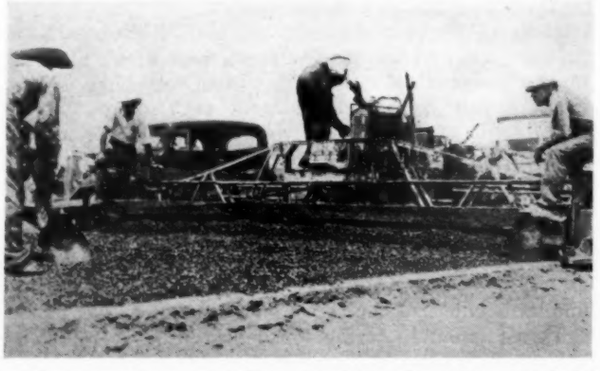
Stone was batched from a weighing bin batcher set directly over the pug-mill type mixer. Stone was handled from cars to stock pile or bin with a small crane and clam shell bucket. Asphalt was weighed before being introduced into the mill. A mixing period of 45 seconds was specified, which proved to be ample to produce a good mixing of the stone and asphalt. The mixed material was dumped from the mill directly to dump trucks and hauled to the job.

Concreting the 2-Ft. Widening Section.

Placing and Spreading the Mix

The old concrete base was prepared by cleaning all cracks and filling them with asphalt, cleaning the surface of the concrete by sweeping, and then treating the entire area with a tack coat of cut-back asphalt, about two-tenths gallon per square yard, which was applied by means of a power driven hand spray. At times it was necessary to add a small amount of gasoline to this tack coat in order to make it handle properly. The tack coat was usually applied to the pavement several hours in advance of placing the asphaltic mixture.

The stone and asphaltic mixture was dumped from trucks directly onto the roadway, levelled roughly by hand, and then spread to proper cross section with a standard concrete finishing machine. After spreading the mixture was left for several hours in order to give opportunity for the volatile parts of the oil to evaporate. Traffic



Standard Concrete Finishing Machine Spreading Asphaltic Mixture.

was carried on the shoulders of the road during these operations, although in case of rain or other sudden emergency the entire road was opened to traffic without apparent damage to any of the work. After the mixture had set for several hours a power grader was put to blading the surface, and this blading was generally continued for a day or so before any attempt was made to use a roller. The depth of the completed asphaltic concrete surface varied from less than 1 in. to as much as 5 in., due to the extreme roughness of the old pavement, and it was found that a smoother surface resulted if the mix was compacted over a period of several days by blading and traffic rather than by rolling. During the blading and the subsequent rolling traffic was allowed on the road.

After the compaction period, which usually lasted a week or more, the surface of the finished road was sealed with a light treatment of the same asphalt used in the mix, this being applied at the rate of about two-tenths gallon per square yard with a hand spray, and covered at once with concrete sand. Blading and rolling was continued after the application of the seal coat.

Unusual Features of Work

The unusual features of this work are the rather unorthodox methods used in compacting the surface to secure a smooth riding profile, and the small asphaltic content of the mixture. It was believed that compaction by raking

and rolling would not result in a smooth surface, because of the extreme variations to be found in the thickness of the asphaltic mixture. This theory seems to have been proved by the results secured, since the surface is much smoother than is customary in such work. In regard to the asphaltic content, the amount of cut-back asphalt used in the body of the mix was 92 lb. of the oil per ton of stone, or about 4.6 per cent since only 62 per cent of this was bitumen, the bitumen content of the mix figures out as 2.85 per cent. Although this is much less than has formerly been assumed as necessary to provide a stable mix, it seems to be sufficient. It is likely that not all of the voids in the stone are filled, but from previous experience we have concluded that it is much better to have the mix too lean rather than too rich. A tendency to ravel due to lean mixture can be corrected by a seal coat, whereas too much asphalt leads to instability which is much more serious. The winters in Texas are mild, and extreme cold is rare. It is possible that in more severe climates the asphalt content would need to be increased to prevent frost damage, although this is by no means to be regarded as certain. This surface was frozen last winter to its full depth on several different occasions, and seemed to sustain no damage.

Costs

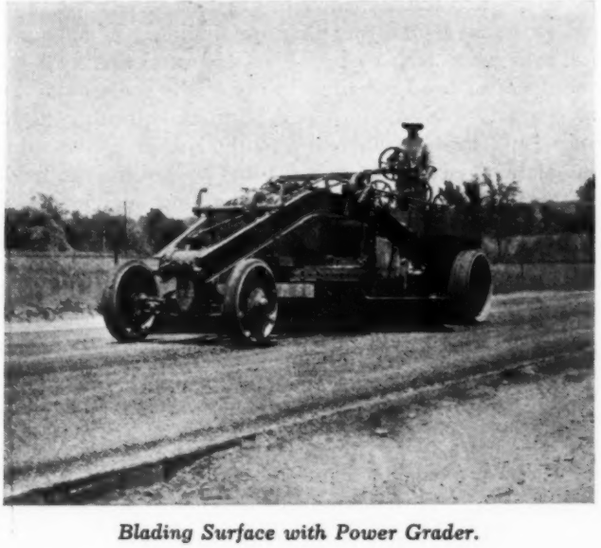
This project was rather costly due to the widening of the old pavements, this part of the work having cost $81,157 for 9.73 miles, or about $8,400 per mile. The surface, however, was not unduly expensive. A total of 191,900 sq. yd. of surface were laid at a cost of $59,267, or $0.31 per square yard, including the tack coat and the seal. These figures do not include the cost of engineering supervision, which was 3.1 per cent of the total cost.

Special Arrangement of Striping at Summits

Mention was made above of a modification of our usual center striping practice designed to reduce the danger of collision at the summits. This plan, briefly, was to begin the center stripe in the center of the standard 20 ft. width as the summit is approached. In approaching the summit the width of the pavement is gradually increased to 30 ft., and then gradually decreased the other side of the summit to the standard width. The center stripe follows the right hand edge of the pavement, maintaining the standard 10 ft. traffic lane, thus causing vehicles to swing to the right as they approach the summit, leaving the center lane clear for such drivers as may elect to try to pass on the summit. Cars approaching from the other side are similarly caused to take the right side by a stripe on that side. As soon as the summit has been passed, and the sight distance is again normal, the stripe is cut off. This has proven to be very effective indeed, and no collisions have happened since these stripes were painted.

Striping at the Summits.

This project was carried out under the supervision of the writer as Division Engineer, and Mr. C. C. Todd as Resident Engineer in immediate charge. Austin Road Co. was the contractor.



Blading Surface with Power Grader.

▼

Day-Labor and Force-Account

To the Editor:

May I have a bit of your space for an appeal to that small percentage of the civil engineers of the country who fail to differentiate between day-labor and force-account methods of carrying on construction and thus perpetuate a deplorable and entirely unnecessary confusion in terminology. Except in direct quotations from other sources, I have never noted this error in contractor's magazines such as *The Constructor* of the A. G. C. of America and *The Bulletin* of the G. C. A. of New York; though I have been a constant reader of both these magazines for many years.

Force-account is not "a development of the day-labor system," but is distinctly a part of the lump-sum contract system. That is, the term arose on lump-sum contract work when part of the work, such as foundations, could not be designed readily in advance and therefore could not be included in the bid. These parts of the work were not "extras," but were foreseen; and it was only natural to designate them force-account work since the engineer was required to keep account of the force of the contractor employed upon them. Thus the effect was really to apply a cost-plus method to parts of a lump-sum contract.

This confusion in terminology can be eliminated very easily if all engineers will restrict the term force-account to this original meaning and I am sending this communication to the editors of several engineering magazines in the hope that this desirable purpose may be consummated as quickly as possible, since delay only adds to the confusion.

Fred A. Barnes,
Professor of Railroad Engineering,
Cornell University, Ithaca, N. Y.

What Is Expected of Our Highways?

By THOS. H. Mac DONALD
Chief, U. S. Bureau of Public Roads

SUCH a simple question would appear to have an easy, almost obvious, answer. But place this question before ten individuals and it is likely there will be ten different answers. Extend the inquiry further and the answers will continue to vary widely and to be limited only by the number of groups approached. Each of these reactions may be different, may be even antagonistic and yet be wholly sincere and logical taken singly as related to the individual or to one group. Not only is this wide variation existing now, but the greatly desired highway services of the moment are quite different than those of five or ten years ago and much different than we must believe they will be in the future.

Is there any wonder the highway official and highway engineer ask in bewilderment, what is expected of our highways? To no group is this question quite as important as to the members of the American Association of State Highway Officials. The success or failure of each State highway department and of the Federal Bureau of Public Roads will be very largely determined by the degree to which the public's expectations of at least reasonably adequate highway service are met, regardless of limiting conditions. At the moment there is a decided trend toward criticism of highway administration and the highways that have been produced. It is a situation to be met frankly. The public are entitled to, and must have, full information upon highway policies and the indicated needs. The public must be taken into full partnership in the matters affecting the highway budget and the highway program of maintenance and construction. Not until these are accomplished facts will the highway officials have fulfiled their responsibility or have done everything possible to secure public support. Over a long period, the progress made in each State will depend upon the confidence and support extended by the public upon the basis of information supplied by the highway departments.

When the full situation is intelligently disclosed and supported by the facts, the responsibility for providing the necessary legislation and adequate support funds rests fairly upon the State as a whole. Whatever failure there is then can not be charged against the highway officials.

The United States has been passing through a period of highway transportation development that has no parallel in any country and that can not possibly be paralleled here by a similar experience in the future.

Increased Highway Mileage Demanded in 1923

What have we expected of our highways? In the year 1923, there were in operation 15 million motor vehicles. Now, in 1937, 14 years later, there are in operation more than 28 million—an increase of nearly 100 per cent.

In 1960, it has been competently estimated,* there will be 37 million motor vehicles in operation, which would mean an increase of 32 per cent in 23 years. But in 1923 when the number of motor vehicles was one-half that of today, the normal speed was about one-half to two-thirds the present normal speed of passenger cars. Yet it is easily remembered that the public expectation—rather, its vociferous demand—in 1923 upon the highway builders, was not to provide roads that in 14 years would carry two vehicles for each one, and these moving at unforeseen higher speeds, but to build surfaces with the greatest possible economy to permit stretching the dollars over the maximum mileage of main routes as yet impossible for motor traffic in wet weather. No matter how far visioned, the highway designer was dealing not with the future but with pioneer necessities. To criticize what has been done only displays ignorance of the conditions that were controlling.

*See Charles F. Kettering—Motor Vehicles and Highways of the Future.

Increased Highway Capacity Now Demanded

What do we now expect of our highways?

Evidently the first answer is that the public expects the highways that are being built today during their reasonable life must carry an additional traffic load of 32 per cent in number of units and an additional unknown per cent due to the increased per unit use. In these we find factors of change that may with some degree of certainty be provided for in highway design.

But what do we expect of our highways in other respects? Is it expected that highway transport is to be so changed as to take on the major characteristics and services of rail, air or water transportation? It is true that the fitting of each type of transportation into the national economy where each can perform its most efficient service and develop its own most useful characteristics is difficult and as yet far from completed. But the pattern is gradually emerging. In this the great utility of the motor vehicle for local transportation purposes becomes constantly more apparent. While this is not in any sense intended to be a discussion of types of transportation, so much is nececcsary as a background for the conclusion that to develop the highways of greatest service we must hold steadfast to the planning and building of adequate local systems in both metropolitan and rural areas. There should be no need for uncertainty if the facts available are properly evaluated. It will be most helpful to highway administrators when the public makes up its mind that highway transport is not fitted to invade the fields of mass transportation and heavy hauling over long distances which belong to rail and water transport, or to emulate the speed characteristics of air transport.

There is too much hazy thinking. There has been too much of the spirit of controversy and too little hard study and analysis of the transportation services required or desired by the public for the purpose of adjusting these to the best transportation method or combination of methods.

The Highway Planning Surveys

In the highway field new policies and new activities that are now under way give assurance that the future

of highway development will more and more rest upon sound research. The list of progressive steps is impressive and at the top as the major undertaking are the State-wide planning surveys now in progress in 43 States. Many of the States are rapidly reaching the second stage of the highway planning surveys. The field surveys and the gathering of the factual data have been large scale operations and have required State-wide organization and direction. In general, these surveys have been satisfactory in the thoroughness and quality of the material gathered. While this first stage is important and necessary, the second stage—the analysis, assembly and study of the survey data—is more important than what has been done. A vigorous attack upon the mass of accumulated data is required to bring the several kinds of factual information to understandable and usable form. This will not be accomplished easily or quickly. It will require the most intelligent effort of which each department is capable. It is the most worth-while task ahead to which the commissioners and chief executives of the departments can give their best efforts and ample time. The factual data must be squeezed dry of pertinent information to be used as a foundation for a sound future highway administration program.

But from this effort intelligently and painstakingly carried to completion will emerge a true pattern of the present use, of the indicated needs, of the strength and weakness of our highways, State by State. It will be possible for the first time to bring the income and the demand for expenditures into parallel columns. Likewise it will be possible to correct legislation that is now outmoded and to formulate new legislative policies based on factual information.

The Development of Design Policies

Coordinate with the highway planning surveys, is the work of the Special Committee on Administrative Design Policies of this Association. While this Committee has just held its second session, this does not mean that the Committee must start at the beginning to develop design information. The policy of the Committee is to review all the previous results of research and the studies which have been made in the field to bring this all-pertinent information together and by this means to disclose the blind spots in existing information. It has immediately become apparent that many of the practices developed through research, on which we are now relying, must be discarded or materially modified as a sound basis for design practice because of the changed conditions. The major subjects will be considered in so far as possible in order of importance. For example, the first subjects are highway classification and sight distances. As rapidly as policies are formulated that are in agreement with the best information that can be secured, these design policies will be made available to the members of the Association and will become effective for the Federal aid highway development.

Railway-Highway Grade Crossing Elimination

Unquestionably we will look back upon the substantial program of railroad-highway grade crossing elimination as one of the most advanced and productive undertakings of this period. Since the Public Works program started in 1933, there have been 3,506 new projects programmed for elimination or reconstruction of existing inadequate structures. Of this total, 66 per cent are now in service. It must be remembered that these projects are selected as nearly as possible in the order of their importance on the basis of the combined railroad and highway traffic carried. This means that we are rapidly doing away with the most important and therefore the most dangerous crossings in every State. In addition to the crossings eliminated, there have been during the same period, 2,249 projects programmed for protection.

While it is admitted that only the actual elimination of grade crossings is a solution, there are a great many crossings where the combined traffic is so small as to postpone the possibility of their elimination for an indefinite period. We must then resort to protection devices which must be at once low-cost and so designed as to give ample warning. Without being limited by the amount of highway traffic, the elimination of all grade crossings on fast through rail routes remains a major policy. This will mean that as the grade crossing program continues, we must be more discriminatory in the selection of the projects to be improved and can not continue to use, without modification, the present method of division in such a fixed ratio between the various railroads.

Soil Stabilization

In the field of soil stabilization the technique and practical application are steadily moving forward. In this development we have, for the first time, some assurance of the possibility of building really low cost roads where traffic service requirements are also in the lower ranges. It is apparent that this is a field in which a little learning may be misleading or even quite dangerous, and it is more than desirable that in each State highway department there shall be technicians fully abreast of the rapidly developing science in this subject. It is the purpose of the Bureau to continue short courses of instruction in theory and practice of soil stabilization, and these courses are open to the engineers of the State highway departments.

Some Design Items Have Matured Slowly

It is the opinion of those in the Bureau who have devoted long years to the studies, that the possibilities for better and more durable construction inherent in the application of the principles which are becoming more and more clear, have matured only in a very limited way.

While there has been a general advance in the details of design and standards of construction, attention should be called to the desirability of a more general adoption of such items as flatter slopes, raised curbs on both concrete and bituminous construction, paved gutters, the use of top soil and fertilizer on shoulders and slopes, and all other design items that will prevent soil erosion.

On a nation-wide basis the highway builders have an important part to play in furthering the national policy of soil conservation.

Drastic Revision of Certain Highway Policies Important

A critical condition is being reached in a number of States in highway affairs. This condition is the outgrowth of diversion of income, refunds of large amounts of highway user taxes collected, and bad organization. A stage has been reached, or is being rapidly approached, where the very large maintenance costs, obligations on past indebtedness, and other demands are absorbing almost the entire income, leaving no balance for reconstruction or

for new construction, and of course this does not permit covering the Federal allotments with State funds. These conditions are often inherited and are not the product of those now in control, but the important consideration is the drastice revision of policies to overcome the drift toward highway bankruptcy. A considerable amount of the difficulty is chargeable to fallacies of so-called low cost construction which have now proven themselves to have been excessively high cost construction. Low cost road building is desirable where applicable to conditions, but the annual cost of our highways is the ultimate and critical cost. The cost of road maintenance should be determinative in the selection of design types in so far as possible.

The calendar year 1936 marked a high point in the mileage of highway construction completed under the joint direction of the State highway departments and the Bureau of Public Roads. Last year 19,054 miles of all types were completed which has only been exceeded slightly in one previous year—1934.

$565,000,000 of Federal Funds Available

At the present time a program of work, including the 1938 Federal aid funds, is available to the extent of $565,000,000 which requires $220,000,000 of State funds. A large part of this total amount available has been programmed. The work is lagging in a number of States, particularly in those States where the highway organizations are wholly inadequate to place under way the available sums, although these are the States which need the work most seriously.

Highway Safety

Up to this point highway safety as such has not been isolated. It is established now that the safety of traffic is influenced by a large number of factors, and that all accidents are the result of a combination of these factors, each contributing in some degree. It will be recognized, then, that this whole discussion bears upon highway and street safety in so far as it is possible to remove our highways and streets from the role of accident factors.

It must be emphasized that the extent to which the use of streets and highways can be made safe by highway design alone is as yet purely conjectural. Accidents do not result from the careful use of highway facilities, even though inadequate; but this does not relieve the highway administrator from his responsibility to design and build and re-build highways to standards that permit the safest possible use. The highway engineer, in his great effort to serve the public, by designing meagerly and as he thought economically, is now being paid in public criticism.

Roadside Improvement

Likewise, the highway administrator has been mistaken in not attaching the same degree of importance to the planting and improvement of the roadsides, as to the building of the roadways themselves. Out of really adequate highway facilities comes the safest possible use of our highways; out of the proper grading and planting of the roadsides come not only safer highways but their protection against erosion and consequent deterioration. The proper treatment of roadsides under trained and experienced direction can be made a large factor in economical maintenance. This advanced thinking in roadside treatment is demonstrated by the really marvelous improvement that the State of Massachusetts has achieved in a period of only a few years. This Association is fortunate to have the opportunity to see the transformation from ordinary highways to veritable parkways which has been brought about by the extensive program of intelligent roadside improvement, and which has been made a permanent policy of the Massachusetts Department of Public Works, applying to all future work. The State in this respect has set an enviable example, and is to be congratulated.

Also, the Association has the opportunity to inspect new highways designed in the modern manner to fit metropolitan needs. The Newburyport Turnpike and the Boston-Worcestor Highway are examples of the construction necessary to unbottle our cities. The Pulaski Highway in New Jersey, the West Side Improvement in New York City, the San Francisco Bay Bridge, the Lake Front Drive in Chicago—all accomplishments of the past very few years—in common with these new highways radiating from Boston, are examples of the type of projects which will be necessary to free our cities. The implication of cost and effort indicates the need for the adoption of very different policies for the administration of such projects.

Change in Public Policies Needed

Finally, the highway engineer speaks, as to what he must have from the public if he is to serve it well. He has put into effect on an individual State basis the nationwide planning surveys from which sound future programs can be developed; an intensive study of design practice out of which will come the necessary standards; the control of soils to insure greater durability of construction; the improvement of roadsides to provide beauty and contribute to the national soil conservation program. But there are two fundamentals which he does not have and which he cannot secure without a change in public policies: First, the rights of way necessary not only for the highway improvements themselves, but the additional land necessary to protect these improvements. Some of the arterial highways which we are building today, because of the lack of control, or divided control, or uncontrollable local control, of the roadsides, will become congested city or village streets tomorrow. The highway authorities are unable to carry out expensive construction improvements and to pay for the acquisition of high-cost land out of current revenues. These costs should be divided, and the land costs paid out of long-term bonds issued to cover such projects. There is no form of investment that would be more safe or prove a sounder one.

The second fundamental is the stabilization of our highway organizations. Under our form of government we can always expect changes at the top, but the men who constitute the going organization and who are essential to its continuity and efficiency, must be put upon a career basis by the establishment of proper Civil Service policies. It is hopeless to expect the public business of highways to be run on an efficient basis unless highway engineering is put on a professional basis with assurance of uninterrupted service as compensation for training, intelligence and devotion to duty.

Acknowledgment—The foregoing is a paper presented Sept. 27 at the 23rd annual meeting of the American Association of State Highway Officials.

THREE MODERN TIMBER HIGHWAY BRIDGES

By IRA D. S. KELLY and
FRANK P. CARTWRIGHT

Structural Engineers National Lumber Manufacturers Association and The Timber Engineering Company

THREE new timber highway bridges now under construction or recently completed, illustrate modern trends in bridge design and construction of interest to bridge engineers and contractors responsible for the design and erection of structurally adequate low cost timber highway bridges.

A through truss bridge of 84-foot span in New Hampshire and a low truss bridge of 91.5-foot span in Pennsylvania provide examples of the application of timber connector construction to highway bridges. The 3½-mile trestle now under construction across Albemarle Sound in North Carolina meets a difficult problem with respect to wave action, and the unsupported length of piling, by means of bracing connections of an improved type designed to provide required lateral and longitudinal rigidity without carrying the braces below water level.

The Pennsylvania bridge employs creosote-treated timber low trusses made possible in timber through the use of split ring and shear plate connectors in all strength connections. The New Hampshire bridge uses a housing similar to that used on early New England bridges in order to protect from the weather the untreated timber used in the structure. All three bridges involve the use of Federal funds.

Albemarle Sound Bridge

Since Colonial times wayfarers have wearily toiled around Albemarle Sound, along the Atlantic coast of

Buffalo Creek Bridge—1937, Shippensburg, Pa.

Pile Driving Rig on the Southern Trestle on Albemarle Sound Bridge. An Average of Three Bents of Four 90-ft. Piles Each Are Driven, Capped, and Braced Daily.

North Carolina. But now that state is constructing a new highway trestle bridging over this obstruction to highway travel. This bold project, costing approximately $1,500,000, will shorten coastal highways from North to South by nearly 15 miles and will bring people in the Norfolk area some 75 miles closer by highway to those living in the territory immediately south of Albemarle Sound. The bridge (18,000 ft. long) is part of a cut-off on U. S. Route 15, to extend between a point east of Edenton on the north and Pea Ridge on the southern shore.

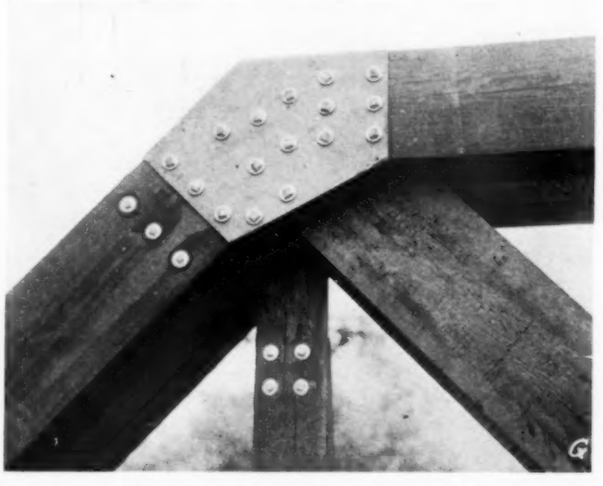
A 330-ft. steel swing span about 1½ miles from the north shore will provide access for shipping to the upper part of Albemarle Sound. The remaining distance will be spanned by a creosoted timber pile trestle supporting six lines of steel stringers and a reinforced concrete floor.

While this type of trestle is not unique, it meets some unusual conditions. The depth of water in the Sound is from 20 to 25 ft. for most of the distance. Below this water is a soft alluvial bottom of approximately equal depth. Wave action resulting from the sweep of the wind across this wide expanse of open water requires a roadway elevation approximately 18 feet above water level. These conditions require treated timber piles ranging in length from 60 to 96 ft. which, when driven, are substantially free standing for a considerable portion of their length. The span between bents is 25 ft, and a longitudinally braced bent is provided every 200 ft. to resist longitudinal forces. Lateral resistance of these long pile bents against wave action is provided above water level by double systems of lateral timber bracing fastened at both ends to the piles with flat or single curved spike grids, recently introduced into American bridge practice to increase the strength, rigidity and life of timber substructure units. The load capacity of these malleable cast iron spiked grids, as indicated by test, is more than four times that of the usually employed ¾-in. bolt. This increased strength of bracing connections reduces the possibility of sidesway and the enlargement of bolt holes under the pounding of the waves.

Pile Bents are Complete and Braced about 200 Yards from the Northern Shore. Pouring of the Deck Has Begun.

Pile bents are capped with 11 in. x 13 in. timbers to which the upper ends of the 3 in. x 10 in. pile braces are attached with flat spike grids. The lower ends of the braces are connected to the piles by means of spike grids curved to fit the rounded surface of the pile. Connection between the inside pile heads and the caps is made by a special bolt passing through the cap and down along the side of the pile head where it is flattened to engage the projecting hub of a 3⅛ in. malleable cast iron toothed shear plate timber connector. All bolt holes and connector seats are field treated with creosote before the bolts are installed and the shear plates are embedded in their seats.

Piles for the northern trestle and for fenders at the swing span are being driven with an unusual rig specially constructed for the job. In order to reduce the time necessary to place a single lead floating pile driver in position to drive the piles, two sets of steel leads were pin-connected to a steel A-frame. Both plumb piles can be driven from these leads without changing position. The bottoms of the leads are then pulled out sufficiently to give the necessary batter for outside piles and toggled in position; the bent is then completed. Piles are handled from barge to leads with a whirley crane at the rear of the pile driver barge. Driving on the southern trestle is proceeding rapidly. Here also a specially designed rig is used, spanning three bents and provided with a stiff leg derrick to handle piles from barge to leads.

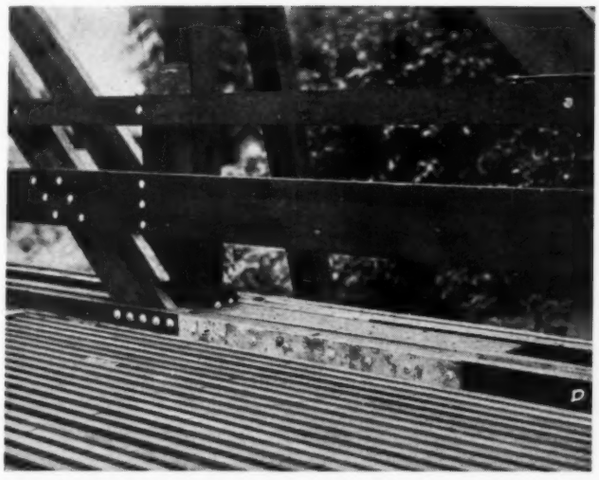


Joint at Top of End Post of New Shriner's Island Bridge Showing Steel Gusset Plates Used with Plain Flanged Shear Plates and ¾-in. Bolts.

The Albemarle Sound Bridge was designed by the State Highway and Public Works Commission bridge design office under the direction of Mr. W. L. Craven, Bridge Engineer, and is being constructed under the supervision of Mr. J. B. Broach, Associate Construction Engineer. Construction contracts are held by two firms, the Tidewater Construction Co. of Norfolk, Va., for the northern approach and the swing span, and the T. J. Loving Co. of Goldsboro, N. C., for the southern portion of the trestle. Treated fir timber piles are furnished by Dant and Russell of Portland, Ore., through the Gulf States Creosoting Co., and Southern pine piling is being obtained from local sources. Spike grids and toothed shear plates were furnished by the Timber Engineering Co. of Washington, D. C.

New Shriner's Mill Bridge

About one mile from Lewisburg in Union County, Pennsylvania, over Buffalo Creek, there stood for many years one of those covered highway bridge landmarks so frequently reported a thing of the past but which still persist and are in daily use in many sections of the United



View Showing Laminated Timber for Composite Timber-Concrete Floor of New Shriner's Island Bridge, a Lower Chord Joint and Splice Using Both Timber, Steel, Splice Plates with Split Ring and Toothed Shear Plate Connectors, and a Portion of the Timber Handrail.

States. The Shriner's Mill bridge consisted of two solid timber arches of white pine supporting timber floorbeams and a white oak plank floor, all housed in with hemlock trusses. But the flood on the Susquehana River in the spring of 1936 backed water up into Buffalo Creek so fast and high that the Shriner's Mill Bridge was floated from its masonry foundations and carried upstream.

The new Shriner's Mill bridge is on State Route 59036 and consists of two 91 ft. 6 in. creosote-treated timber spans resting on the old masonry foundations with new concrete caps. It uses low Pratt type trusses connected by solid section floorbeams with outriggers at their ends and supporting a continuous composite timber and concrete floor.

All joints in this bridge use split ring or shear plate timber connectors. The sizes and sections of timbers used in the trusses are characteristic of this type of construction. The chords are built up of four wide and relatively thin members between which are inserted similarly wide thin web members.

The procedure followed in supplying the treated structural timber for this project closely followed customary steel fabrication practice which differs markedly from traditional timber bridge construction. From the design drawing a complete set of shop details was prepared showing each piece of timber required. From these details templates of 1 in. S4S dry Western red cedar were prepared for each different piece of the structure and checked by assembly in a half truss. All timbers were then marked from the templates for all holes, seats and cuts. The timbers were then cut to length and shape, dapped where required, bored for bolts, seats cut for split rings and two types of shear plates, marked with metal tags for identification and checked from the shop details.

Main Trusses of the Hancock-Greenfield Bridge Assembled for Drilling. Note Camber in the Top Chord. Assembly on Top of Main Trusses Is a Floor Beam Truss.

A check assembly of the longitudinal half of one truss was then made to prove the accuracy of fabrication and check the amount of camber provided. Completed timbers were loaded on trams and sent to the treating cylinders where they received a ten pound empty cell creosote oil treatment. The timbers were then shipped without assembly to the bridge site where erection in place on falsework was carried to completion by the contractor.

Fifty-five thousand seven hundred board feet of treated Southern pine timber were required for the complete structure. Of this amount, 15,000 board feet were 2 in. x 4 in. and 2 in. x 6 in. strips used in the composite timber-concrete floor, about 10,000 board feet were used in floorbeams and outriggers, and about 30,000 board feet were used in the trusses.

The design and shop details were furnished by the Timber Engineering Company to the Commonwealth of Pennsylvania, Department of Highways, Mr. E. E. Brandow, Bridge Engineer. Fabrication and treatment of the structural timber required was done by the Wood Preserving Corporation, Century Division, at its Newport, Del., plant, and timber connectors were supplied by the Timber Engineering Co. Construction was by Thomas B. Evans, Contractor, Danville, Penna.

Portal Bracing Similar to the Truss Shown in the Foreground Was Employed at Each Bent of the Hancock-Greenfield Bridge. At Rear Is a Trussed Floor Beam. Upper and Lower Chords of Floor Beam Trusses Were Connected to Verticals Affording the Main Trusses Considerable Lateral Support.

Hancock-Greenfield Bridge

This bridge, of 84-ft. span, 24-ft. roadway, and designed for an H-15 loading, is nearing completion on a secondary road between the towns of Hancock and Greenfield, New Hampshire. It employs the housing traditional on old New England bridges, but the supporting structure utilizes timber connectors for all member connections. Chords are two-member, with the web system between the two pieces. Clearance under the trussed portal bracing is 17 ft. 6 in. The deck is of laminated timber, and floorbeams are shallow timber trusses.

Procedure in building this bridge was different from that employed on the new Shriner's Mill bridge in that the component members of the portal, floor beam, and through trusses were assembled at the site in the relative positions they will occupy in the finished structure and holes were drilled through each assembly at points shown on the plans. The pieces were lifted apart, and grooved for connectors which were immediately installed. The trusses were then reassembled and erection carried on in large units.

The contractor is Hagen & Thibodeau, Wolfeboro, N. H.; fir and Southern pine timber and connectors were furnished by the George McQuesten Co., of Boston, Mass.

OBSERVATIONS BY THE WAY

By A. PUDDLE JUMPER

¶ This picture needs a little explanation to appreciate it. The dancing dolls are projects of merit that were completed and supported by Mr.

Vail. Colorado 50 Association is a delegation from highway U.S. 50 trying to get Vail to do a good job on U.S. 50. Vail says, "It can't be done. The good Lord did not build 'Nell' right in the first place." Note the bag of gold under Vail.

• •

¶ At historical points along Montana's state highways the state highway commission has erected historical markers in the form of panels on which is a description of their interesting history. I stopped at most of them to read the panel. Good stuff, I say. The expression, "Thar's gold in them thar hills," originated just south of Helena.

• •

¶ Let's hope North and South Dakota get their roads all-weather surfaced and dustless before many more years pass. The garage and tire business in these states must be very good.

• •

¶ Have you seen the earthwork cost calculating slide rule for scrapers, which Le Tourneau devised? Cost calculations for various tractor speeds and various operating efficiencies at various rates of cost per hour are read from the slide rule to give cost per cu. yd. on various lengths of haul.

¶ If you visit New York City be sure to drive around and see the many bridges. New York believes in keeping traffic moving.

¶ The tank truck shown herewith is the type of hauling unit which causes concern to bridge engineers.

This picture was taken in Sacramento, Calif. Will your bridges stand the concentrated loading of these units?

• •

¶ Can you guess the origin of the expression, "The Northern Horde?" Ask California's assistant engineer, Wm. McCoy. If he's forgotten ask Lacey Murrow, Director of Highways in Washington. Therein lies a story.

• •

¶ If you're in a hurry to go east from Portland, Oregon, I suggest you cross the river to Vancouver, Washington, and take U.S. 830. The Columbia River highway in Oregon is not near so fast a road. The latter is picturesque and has many natural beauties along it which attracts tourists and consequently slows down the through driver.

¶ There are a lot of things that happen and exist in the highway industry that I can't understand. Maybe I'm dumb, but if so, I'm not alone. Another thing I can't understand is why Mississippi requires edging on a center joint when ⅛ or 3/16-in. preformed, prepared, machine placed bituminous center strips are used in concrete road building and no edging is required when steel contraction joints are used. I can name several states that do not edge the longitudinal joint even up to the ⅜-in. thick preformed mastic joints. Is it just to be different?

• •

¶ Did you know that one manufacturer is now testing out a 40E paver? Which, brings up the question, "What is the economic maximum size of pavers?"

• •

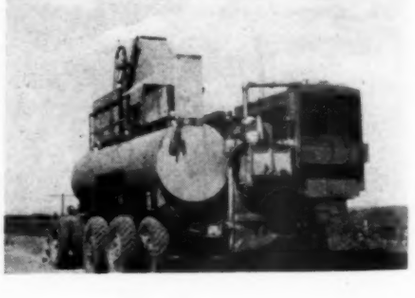
¶ Another thing I can't understand is why so many cities seem to love their old rough paved streets. They must love them or they'd build smooth ones.

• •

¶ Practically everyone has seen pictures of the highway through the Redwoods in Northern California and Southern Oregon, so I did not take one. How many know that a road goes through one tree, a canteen is set up in another, and rest rooms or comfort station is in another?

• •

¶ I noticed the bituminous mixer shown below near Pukwana, So. Dak. It is owned by the Summit Const. Co., of Rapid City, So. Dak., and is the only one built. The manufacturer never made another one I was told.



¶ Type of street sign used in Hastings, Nebr. It is made of concrete and placed near curb radius on intersec-

tions. There are two of these signs on each intersection to be seen from different directions. A good idea.

• •

¶ An idea suggested to A.P.J. is that those advertisers who use big billboards along the highway might be convinced to eliminate the billboard and purchase a small plot of ground along the right-of-way and build a roadside rest spot. They probably would be allowed to erect a bulletin board in the spot and derive as much advertising value that way as by using a billboard.

• •

¶ A machine made by Spears-Wells Mchy. Co. of Oakland, Calif., shown working on Sutter's Fort Street in Sacramento, Calif., heats the bituminous surfaced street before short 3/16 in. thick blades shear the top smooth. The accompanying view shows this Spearwell heater planer that uses either butane or propane gas to feed the burners. The hydraulically controlled moldboard cuts a 42 inch swath at the rate of 3 ft. per min. Note the windrow of planed off material.

¶ Wm. C. (Perk) Perkins, Chief Engineer, Eastern Region, National Paving Brick Assoc., claims Prof. J. S. Crandell, Univ. of Illinois, established his brand of cigar as "Engineers Cigars." Said Crandell:

"Dear Perk:

This is just to tell you that your cigars are much better than George's customers' cigars, such as he handed out to me! The one he gave me burned at an angle of 43° with the longitudinal axis, and with some amount of parallax. Yours burn with the cosine of obliguity of not more than+or—5°.

J.S.C."

• •

¶ Have you noticed the hub-rail design on some of Nebraska's new bridges? They are good.

• •

¶ How the State of Oregon identifies its road maintenance equipment is shown by the accompanying picture.

The 37 indicates the year purchased. The figure 3 of 361 means third district and 61 is the truck number.

• •

¶ I certainly am struck by the cordiality of highway departments on the West Coast as compared with other places I could mention.

¶ Removing excess surface asphalt from new brick paving. Asphalt used to fill the joints is poured on the brick,

very hot, after the brick top surfaces have been painted with a solution which prevents the filler from sticking.

• •

¶ Certainly reflectorized advertising signs along highways should be prohibited, as should likewise all self-illuminated signs which tend in *any way* to confuse motorists. The little reflector buttons, when used on highway safety or directional signs, on bridge ends or parapet walls, on guard rail posts on curves, as traffic division markers, and in many other ways, are rendering an inestimable service. But used in advertisements, which to be effective must fall within the beam of approaching headlights, they are at their best a cause of distraction and uncertainty, and at their worst a positive menace. Many self-illuminated signs are as bad or worse. Our night accident record calls for the correction of all such conditions.

• •

¶ It would be a good thing if the 15-ft. pavement on Illinois Route 1 could be widened and some of the bad curves corrected. There is a considerable mileage of the 15-ft. width in several separated sections, and these constitute a traffic menace in spite of carefully placed warning signs. Many of the curves are dangerously sharp in spite of heavy superelevations.

• •

¶ However, not all of Route 1 is bad. If you want a chance to observe good pavement of two different types, follow it through Westville, south of Danville, and you will find several alternate sections of new brick and concrete of adequate width and delightful smoothness.

★ ★ ★ ★ ★
ROAD SHOW and
CONVENTION
Cleveland, Ohio
January 17-21, 1938

ROAD BUILDERS'

NOVEMBER, 1937 **AMERICAN ROAD BUILDERS'**

1938-39 NOMINATIONS

Down the Road

By CHARLES M. UPHAM,

Engineer-Director
American Road Builders' Association, Washington, D. C.

GOOD ROADS DIMINISH FARM FIRE LOSS

The loss of your home by fire, if you live out from town in the country, can be the direct result of the poor condition of the road that passes your door. Farm-to-market roads that have not been improved and hard surfaced have a habit of going to pieces in bad weather. I remember a case in Delaware. I was at that time engineer for the Dupont Highway. One night I was returning by car to my headquarters town in the south-central part of the state. Rain had been falling heavily, on and off, for about three days and nights, and the condition of the unimproved road over which I was forced to travel made driving a ticklish and sometimes uncertain process. It was about seven o'clock when I sloshed around a sharp curve and noticed the red glow in the sky several miles ahead. In that section of the state that red glow could only mean one thing. Some farmer's house or barn was burning. I reached the scene of the fire and found the farm family and neighbors using an antiquated hand-pump apparatus. They were all doing their best to put out the fire.

The house was a well-built two-story structure and the family was frantic over what was happening to their home. I was told by one of the neighbors that the fire had been a small one at first, having started in a chimney near the ground floor, and had gained headway slowly. When it was seen that the flames were going to spread over the entire side of the house, the fire department in Wilmington, a few miles away, was telephoned for help and every piece of furniture and clothing was removed to safety. If the fire truck had arrived in the quick time ordinarily required for the short trip from Wilmington, the house would have been saved.

We watched with anxiety and pumped with fury, but the odds were against us in our fight to control the steadily spreading flames with such inadequate fire-fighting equipment. All that was left to do was to wait for the fire-fighting apparatus from the city and hope that it would arrive in time. Expectant ears strained to hear the engine roar and siren that would announce its approach and smarting eyes kept looking down the road for headlights they hoped would be those of the overdue fire truck.

The farmer and his family were stunned into speechless dejection at the sight of their home being devoured by flames that they were powerless to extinguish. That home burned to the ground that night because the chemical fire apparatus from Wilmington failed to arrive. It bogged down to the axles on a muddy stretch of road only six miles away. No, the road could not have prevented damage to the house to a certain extent, but it was to blame for the total loss of the house.

Your home, if you live in the country on an unimproved subsidiary road, could be lost by fire the same way. This is but another reason why the Congress of the United States included in its federal-aid appropriations for highways a stipulated sum for secondary or farm-to-market roads. Twenty-five million dollars has been set aside for the improvement of back roads through new all-weather construction and proper maintenance. It is wise, therefore, for those who legislate the expenditure of road funds within the various states to give careful consideration to the road needs of the farmers and others who make their homes and their living on the back roads of America.

MANY HIGHWAY CONTRACTORS PLANNING ROAD SHOW ATTENDANCE

Close to five thousand highway contractors will attend the 1938 Road Show and Convention at Cleveland, Ohio, next January 17-21, if present indications hold true. The executive offices of the American Road Builders' Association in Washington, D. C., are daily in receipt of notifications of the contemplated attendance of special highway-contractor state groups.

Paul L. Andrews, executive secretary of the Georgia Highway Contractors' Association, Inc., with headquarters in Atlanta, sends news of the planned attendance of thirty-five Road Builders from that state.

Word comes from Florida that thirty Road Builders have already made their hotel reservations and will definitely attend the "five-star" exposition of newest machinery, materials and ideas.

A North Carolina delegation of Road Builders plans to leave Durham on Sunday afternoon, January 16, 1938, in a specially chartered car to attend the Road Show-Convention.

REVIEW

★ ★ ★ ★ ★
ROAD SHOW and
CONVENTION
Cleveland, Ohio
January 17-21, 1938

ASSOCIATION—WASHINGTON NOVEMBER, 1937

ANNOUNCED BY A.R.B.A.

MICHIGAN HIGHWAY COMMISSIONER MURRAY D. VAN WAGONER SLATED FOR PRESIDENCY

For President: Murray D. Van Wagoner, Michigan, state commissioner of highways, Lansing, Mich.

For Vice-Presidents: Paul B. Reinhold, secretary-treasurer, Reinhold & Co., Inc., Pittsburgh, Pa.; E. D. Kenna, director, Mississippi State Highway Dept., Jackson, Miss.; Lion Gardiner, vice-president, Jaeger Machine Co., Columbus, Ohio; Stanley Abel, supervisor, Fourth District, Kern County, Taft, Cal.

For Treasurer: James H. MacDonald, consulting road and paving expert, New Haven, Conn.

For Directors, term ending 1941: A. W. Brandt, commissioner of highways, department of public works, Albany, N. Y.; Carl W. Brown, chief engineer, Missouri State Highways Dept., Jefferson City, Mo.; Frederick Hoitt, secretary, New England Road Builders' Association, Boston, Mass.; T. S. O'Connell, state highway engineer, Arizona Dept. of Highways, Phoenix, Ariz.; C. J. Sherlock, first assistant engineer, Alabama Dept. of Highways, Montgomery, Ala.; Charles M. Upham, engineer-director, American Road Builders' Association, Washington, D. C.; H. C. Whitehurst, director of highways, D. C., Washington, D. C.

County Highway Officials' Division

For President: J. C. McLean, county engineer, Woodbury County, Sioux City, Iowa.

For Vice-Presidents: L. O. Marden, county engineer, Worcester County, Worcester, Mass.; H. G. Culverhouse, county highway engineer, Jefferson County, Birmingham, Ala.; J. H. Dennis, county engineer, Genesee County, Flint, Mich.; Lew Selvidge, executive secretary, Washington State Association of County Commissioners, Olympia, Wash.

Murray D. Van Wagoner

For Directors, term ending 1941: Ben T. Collier, county-engineer, Coahoma County, Clarksdale, Miss.; A. C. Droppers, Sheboygan County highway commissioner, Sheboygan, Wis.; Chris P. Fauerso, county engineer, Wasco County, The Dalles, Ore.; Arthur F. Ranney, county engineer, Summit County, Akron, Ohio; W. O. Washington, county engineer, Cameron County, Brownsville, Tex.; Allan M. Williams, county engineer and maintenance superintendent, Ionia County, Ionia, Mich.; Tate Wright, executive secretary-treasurer, Association of County Commissioners of Georgia, Athens, Ga.

Municipal Division

For President: George C. Stanley, city engineer and superintendent of streets, Burlington, Vt.

For Vice-Presidents: W. E. A. Doherty, engineer of construction, bureau of highways, Philadelphia, Pa.; R. W. Gamble, superintendent of street construction, Milwaukee, Wis.; Walter N. Frickstadt, superintendent of streets, Oakland, Cal.; N. L. Marks, city engineer, New Orleans, La.

For Directors, term ending 1941: J. W. A. Bollong, traffic engineer, dept. of streets and sewers, Seattle, Wash.; J. P. Broom, city manager, Petersburg, Va.; George Cobb, highways engineer, dept. of public works, Baltimore, Md.; Thurman W. Dix, commissioner of public works, Barre, Vt.; M. O. Eldridge, assistant director of traffic, Washington, D. C.; D. L. Erickson, city engineer, Lincoln, Neb.; Roy C. Gans, chief engineer, dept. of streets and sewers, St. Louis, Mo.

A.R.B.A. 1937 RADIO SERIES

The American Road Builders Association began its 1937 Radio Series on Nov. 5. The series will be centered around Highway Safety. Over 246 radio stations representing every state and the District of Columbia have arranged suitable periods for the broadcasts. Additional stations are being added from day to day and it is expected an ultimate coverage of over 300 stations. Three broadcast periods in each station are being arranged giving a total of 900 individual talks.

MODERN INCLUSIVE HIGHWAY CODE ENACTED BY STATE OF WASHINGTON

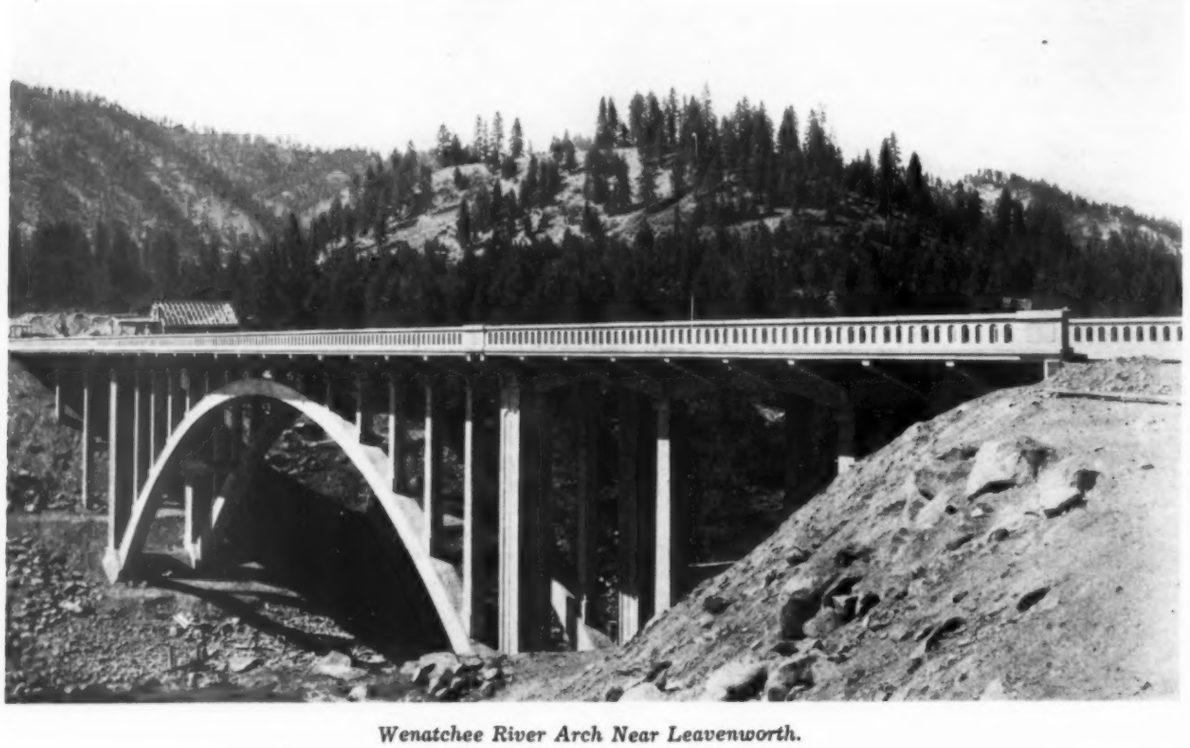
By VICTOR J. BROWN,
Publishing Director,
Roads and Streets

Concluded from September Issue

Features of the Code

State Highway Act.—The Washington State Highway Act is a complete modernization of the law governing the administration of highways comprising the state primary highway system. Primary state highways are designated by convenient number and descriptive name and no primary state highways have been added to those now existing, such additions being left entirely within the determination of the legislature. The mechanics of construction, acquisition of right of way and highway maintenance are unchanged in principle with the one exception that prequalification of contractors is required. The traffic control chapter provides for a uniform state standard of traffic devices and traffic control signals to be adhered to by state, counties and cities and gives authority for certain restrictive and other markings designed to provide safer conditions of operation. Provision is made for taking full advantage of Federal Aid and other Federal Grant Funds. Highway development is provided allowing the Director of Highways to improve unsightly roadside conditions and install roadside facilities. The many voluminous and obsolete sections on this subject are completely repealed, making this new enactment a complete and up-to-date law.

State Highway Aid Act.— The Washington State Highway Aid Act provides for the establishment of county roads and bridges and the vacation of useless roads and completely modernizes the county road administration, correcting the evils and retaining the advantages of the current method. The boards of county commissioners of the several counties are given the responsibility of the construction, care, control and maintenance of the county roads. Elective county engineers are abolished and provision made for engineering assistants who have been qualified under the state engineering license law. The responsibilities of the county with respect to the construction and maintenance of county roads and the supervisory relationship of the state is provided for in an improved form, considering the current practice. Noteworthy is the repeal of hundreds of sections of archaic law relating to toll roads, toll bridges, turnpike roads, independent highway districts and other local improve-



Wenatchee River Arch Near Leavenworth.

ment assessment districts enacted as far back as 1854.

State Highway License Act.—The Washington State Highway License Act revises the auto title law resulting in a saving to the automobile owners of approximately $50,000.00. The auto license law is revised with the attention of the legislature directed to the recommendations of the Highway Cost Commission in the determination of the proper fees to be paid by commercial vehicles. The law provides for the administration and the issuance of license plates with the least public expense and public inconvenience. Notable is the change in the operator's license law which provides that no person with vision poorer than 20-50 shall be allowed to operate a motor vehicle unless their eyesight is sufficient with the use of glasses in which they are granted a conditional license under which they may operate only on the condition that they wear glasses. There is provided a restrictive license for persons who may be restricted to operation in certain localities only. There is provided an examination of operators every four years, which examination is divided into three parts; the first is a physical examination of vision, color blindness, hearing, stereoscopic vision and reaction time; the second is a written examination of 25 questions on the motor vehicle laws of the state which must be passed with 80% proficiency, and the third is a practical driving demonstration. Provision is made that operators' licenses may be refused for cause, suspended for a period of less than a year, revoked for a period of one year or cancelled for an indefinite period under certain conditions. It may be seen that for the first time the State of Washington is asked to direct particular attention to the operator of a motor vehicle, as a potential cause of accidents. The operator's license fee is $1.00 per year and it is calculated that some 400,000 people in the State of Washington are now operating motor vehicles without an operator's license. When all persons are forced to have an operator's license it is expected that the license fee alone will provide for the administration of the Motor Vehicle Act and the enforcement by the state enforcing agency.

Motor Vehicle Act.—The Washington Motor Vehicle Act provides for the periodic inspection of motor vehicle equipment by state operated vehicle inspection stations free of charge to the public. Motor vehicle equipment is defined and it is believed that the provisions require safety equipment which is reasonably necessary and will accomplish the greatest degree of safety in the operation of a vehicle. The size, weight and load of a vehicle engaged in commercial operation is recently restricted, taking into consideration the volume of traffic and the condition of the highway. There is provided a procedure for the arrest for violation to the act and the reports to be made by officers and judges. A complete case record will be kept on every motor vehicle operator and any convictions, accidents or other acts committed by such operator will be filed against him on his case record. If it should be determined, according to the record of any operator, that he is an habitual violator or his record otherwise indicates that he is unfit to operate a motor vehicle, the director of licenses may suspend, revoke or cancel his operator's license and such person would be henceforward denied the privilege of operating a motor vehicle on the public highways of this state. There is further provided a complete central reporting of stolen and abandoned automobiles with a method by which thefts and recoveries, both inside and outside of this state, may be immediately reported to all enforcement agencies. Of the greatest importance is a procedure for the central reporting of automobile accidents, providing that all accidents in cities and towns shall be reported to the chief of police and all accidents outside cities and towns reported to the county sheriff. The original accident report must be forwarded immediately to the Washington State Patrol. It is required that the Washington State Patrol analyze and tabulate accident reports and publish statistics gained from such analysis, that it may definitely determine all circumstances which may be considered a contributing cause to automobile accidents. The State of Washington has never known the causes of accidents and for this reason has been unable to determine scientifically the proper means of preventing them. The central accident reporting and analysis is the most vital provision of the law in a program for accident prevention. On the whole, the Motor Vehicle Act is a complete modernization of the rules of conduct in vehicle and pedestrian traffic and it is stated in simple terms, reasonable in its application and easy to obey and is designed to be strictly enforced. All obsolete laws were repealed and the Motor Vehicle Act provides a concise and easily understandable code.

One laudable clause in the new code reads as follows: "Every vehicle shall be equipped with a device adequate to effectively reduce wheel spray or splash of water from the roadway to the rear thereof." The worst offenders in this respect are the large trucks. This one small section will go a long way toward accident prevention and reduction.

State of Washington
Department of Highways

APPLICATION FOR EMPLOYMENT

Date ..... , 19..

Name ..... Position applied for .....

Address ..... (Street number) ..... (City) ..... Phone .....

Age ..... Married or single ..... Number of dependents .....

Are you a U. S. citizen ..... Length of residence in Washington ..... Yrs.

Name and address of nearest relative .....

..... Have you any relative now employed by the state? (If so give name and department) .....

Education .....

Statement of Experience

Position	Name of Employer	Place	Salary	Dates From	Dates To	Reason for Change

Names of former employers who may be used as references:

(Name) ..... (Address) .....

(Name) ..... (Address) .....

(Name) ..... (Address) .....

..... (Signature of applicant)

H.P. 10.01

Application Blank.

The Merit System.—The 1937 Highway Code in one of the sub-paragraphs under "General Administration" reads as follows: "(g) To devise and place in operation in the department of highways of the State of Washington a practical and workable merit system for the rating of employees of the department of highways and the same shall by him be followed as closely as possible in the classification of employees, setting of wages and the determination of eligibility for promotion, to effect the most efficient and economical conduct of the department of highways."

State of Washington
Department of Highways
Olympia

QUESTIONNAIRE RELATIVE TO EMPLOYMENT APPLICATION

_____, 193_.

Mr._____
_____
_____

Dear Sir:

An application has been received from_____ for employment in this department in the capacity of_____, and he has given us your name as reference.

The applicant states that he was employed by you from_____ to_____ in the capacity of _____ at a salary of $_____

Does the above statement agree with your records? _____

What was the nature of the work on which he was engaged?_____
_____

Were his services satisfactory? _____

Your kindness in answering the above questions will be greatly appreciated, and we would respectfully request your further cooperation in furnishing this department with your estimate of the applicant's qualifications by placing a check mark in the appropriate square (☑) opposite each of the various traits listed. In doing so please bear in mind the position applied for.

Yours truly,

L. V. MURROW
Director of Highways

By
Lawrence R. Turnbull
Engr. of Personnel & Accts.

	Exceptional	Good	Average	Below Average	Unsatisfactory
Skill,.....	☐	☐	☐	☐	☐
Judgment,.....	☐	☐	☐	☐	☐
Integrity,.....	☐	☐	☐	☐	☐
Dependability,....	☐	☐	☐	☐	☐
Initiative,.....	☐	☐	☐	☐	☐
Personality,.....	☐	☐	☐	☐	☐
Ambition,.....	☐	☐	☐	☐	☐
Physical Fitness,.	☐	☐	☐	☐	☐
Citizenship,.....	☐	☐	☐	☐	☐
Financial Responsibility,.....	☐	☐	☐	☐	☐

Remarks:_____
_____
_____

_____
(Signature)

H.F. 10.38

Questionnaire Sent to Applicant's Former Employers.

This activity was first inaugurated in 1934. The new code, however, gave it legal standing. Each man in the employ of the state highway department knows that an efficiency and merit system is in operation. He can feel a bit more secure in his employment, provided he performs satisfactorily. The system helps to develop an esprit-de-corps and a loyalty to the organiaztion. Naturally a gradual rise in the standard of the personnel results which is reflected in lowered engineering costs. Many men do outside study and research work that would not be the case without such a system.

The operation of the system, of course, results in a complete informational record of each employee showing in detail his experience and qualifications. By reference to his efficiency rating which is based upon education, experience, integrity, initiative, citizensip and other qualifications the employee's superior is able to place him where he will be able to give the most efficient serv-

Olympia, Wash.,_____, 193__.

Dear Sir:

Your name is on our eligible waiting list for employment in this Department in Classification____, in the capacity of_____.

As we are desirous of keeping our list up to date, we would request that you kindly notify us on the attached postal card if you are still available for employment in the above capacity should an opening occur.

Yours very truly,
L. V. MURROW,
Director of Highways
By
Engr. of Personnel & Accts.

POSTAL CARD 1¢

REPLY CARD
THIS SIDE OF CARD IS FOR ADDRESS

Mr. L. V. Murrow,
Director of Highways,

Highway Building

Olympia, Washington

THIS SIDE OF CARD IS FOR ADDRESS

POSTAL CARD 1¢

Date _____, 193___.

I {am / am not} at present available for employment in the Department of Highways in Classification ___ in the capacity of _____.

Remarks:_____

Name _____

Address _____

Phone No._____

Opposite Sides of Follow-Up Post Card with Return Sent to Applicants So that List of Available Men May Be Kept Up to Date.

THE New INTERNATIONAL PICK-UP TRUCKS IN 3 SIZES

The ALL-STEEL CAB is a feature in every new International. The one-piece top, the sides, the back and cowl panels are welded into the complete cab frame. Rubber mountings wherever cushioning is needed. This is the roomy, well-appointed de luxe cab.

● In the new International Truck line special attention has been given the popular pick-up type of truck—from the standpoint of appearance as well as all-around utility. The men who design and build and test them took all the time that this kind of a job requires and put into these new Internationals all the experience that Harvester has gathered in more than thirty years of truck manufacture.

Pick-Up bodies are available in 76, 88, and 102-inch (inside body) lengths for use on International chassis in 113, 125, and 130-inch wheelbases. These durable all-steel bodies meet every need in pick-up truck work, offering practical and attractive design. The roomy all-steel cab is designed and equipped for maximum comfort, convenience, and safety under all operating conditions.

It is that way throughout the entire International Truck line. No matter what the load, there is always an International built to fit the job exactly. There are 26 models to choose from, and capacities ranging from Half-Ton to heavy-duty Six-Wheelers. Write for a catalog, or call on the nearest International Truck dealer or Company-owned branch and see the new trucks.

INTERNATIONAL HARVESTER COMPANY
180 No. Michigan Ave. (INCORPORATED) Chicago, Illinois

INTERNATIONAL TRUCKS

January 21, 1936.

SCHEDULE FOR EFFICIENCY RATING OF EMPLOYEES

EDUCATION	30%	To be rated as per schedule below
EXPERIENCE	30%	" " " " " " "
SKILL	5%	5=exceptional; 4=good; 3=average plus; 2=average minus; 1=poor; 0=totally lacking.
JUDGMENT	5%	
INTEGRITY (Loyalty, Honesty)	5%	
DEPENDABILITY (Sobriety, Reliability)	5%	
INITIATIVE	4%	4=exceptional; 3=good; 2=average; 1=poor; 0=totally lacking.
PERSONALITY	4%	
AMBITION	3%	
PHYSICAL FITNESS	3%	3=exceptional; 2=good; 1=below average; 0=totally lacking.
CITIZENSHIP	3%	
FINANCIAL RESPONSIBILITY	3%	
	100%	

Classification of Employees		Education		Experience	
Class 1	Department Heads	High School	10	1 Year, Class 1	10
		2 Yrs. College	15	2 Years, " 1	20
		4 " "	25	3 " " 1	30
		4+ " "	30		
Class 2	Asst. Dept. Heads Asst. Dist. Engrs. Dist. Maint. " Office Engineers	High School	10	1 Year, Class 2	10
		2 Yrs. College	15	2 Years, " 2	20
		4 " "	25	3 " " 2	30
		4+ " "	30		
Class 3	Resident Engineers Locating " Designers Senior Draftsmen-Hdqtrs. Office Supervisors	High School	10	1 Year, Class 3	5
		2 Yrs. College	20	2 Years, " 3	10
		4 " "	30	3 " " 3	15
		(2 Yrs. Experience may be substituted for one year education, C1,3 only)		4 " " 3	20
				5 " " 3	25
				6 " " 3	30
Class 4	Inspectors, Transitmen, Instrumentmen, Levelmen, Topographers, Draftsmen--Field, Dist. Of. & Hdqtrs., Computers	High School	15	1 Year, Class 4	10
		2 Yrs. College	25	2 Years, " 4	20
		4 " "	30	3 " " 4	30
Class 5	Flagmen, Axemen, Chainmen, Rodmen, Checkers	Common School	10	1 Year, Class 5	10
		High School	20	2 Years, " 5	20
		2 Yrs. College	30	3 " " 5	30
Class 6	Foremen, Bridge Supts., Master Mechanics, Shop Foremen				
Class 7	Auditors, Stenographers, Bookkeepers, Clerks, Timekeepers				
Class 8	Equipment Operators, Bridge Operators, Watchmen, Janitors, Cooks, Miscellaneous				

In Class 1 to Class 5, inclusive, education is assumed to be study leading to a degree in an engineering course; otherwise discount it 50%.
Experience is assumed to be experience in this department; otherwise discount it from 10% to 50%.
4+ years college means study in addition to that required for a B. S. degree in an engineering course, as for example, a Master's degree, a degree in Liberal Arts, etc.
In addition to the total rating as obtained by the above, 1/2 point is to be allowed for each complete year of service with this department, which added to the efficiency rating gives the seniority rating.
If an employee's rating in any characteristic other than education or experience falls below the average rating for the particular characteristic he ordinarily would not be considered for advancement regardless of his seniority rating.

Schedule for Efficiency Rating.

EFFICIENCY AND SENIORITY RATING OF EMPLOYEE

Name	Classification	Education 0 - 30	Experience 0 - 30	Skill 0 - 5	Judgment 0 - 5	Integrity 0 - 5	Dependability 0 - 5	Initiative 0 - 4	Personality 0 - 4	Ambition 0 - 3	Phys. Fit. 0 - 3	Citizenship 0 - 3	Finan. Respon. 0 - 3	Efficiency Rating	Seniority Rating
	Promotion	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C		

A = Rating by employee's immediate superior. B = Rating by District Engineer or Department Head. C = Rating by Reviewing Board.
(Leave last two columns blank.)

Form for Reporting Efficiency Rating of Employees. Rating Made as of Jan. 1 Each Year.

ice. It provides a definite basis on which to regulate salaries, promotions, seniority, and all changes in organization personnel.

The accompanying forms show the records that are kept. An application form is filled out by a man desiring employment. The personnel officer then sends the questionnaire to the references given. If there is a vacancy and the man employed, a service record is started and carried forward as indicated by the entries on the forms pictured. Periodically each superior rates a subordinate. These go to the district engineers who place their ratings in Column B next to the rating placed by a foreman or resident engineer in Column A. The rating blank is forwarded to headquarters and in Column C the rating board places its efficiency rating. In this way all ratings are reduced to a relative level. The schedule of efficiency rating shown is self explanatory.

SERVICE RECORD OF EMPLOYEE

Position	Name of Immediate Superior	Nature of Work	Dates From	Dates To	Salary	Seniority Rating Date	Seniority Rating Rating

Name:

Date_____ 19____ Age_____ Years. Married or Single_____ No. of Dependents_____
Permanent Address_____
Name and Address of Wife or Nearest Relative_____
Education_____
Remarks_____

EXPERIENCE PRIOR TO EMPLOYMENT WITH WASHINGTON DEPARTMENT OF HIGHWAYS

Position	Name of Employer	Place	Dates From	Dates To	Salary	Reason for Change

TYPIST PLEASE NOTE--THIS SCALE CORRESPONDS TO TYPEWRITER SPACE SCALE--SEE PAPER GUIDES SO THAT GUIDE WILL REVOLVE WITH RUBBER ROLL WHEN CARD IS TURNED INTO WRITING POSITION. START ISSUE TWELVE (12) POINTS FROM LEFT EDGE OF CARD, USE OTHER POINTS OF SCALE FOR OTHER DIVISIONS OF DOUBLE TITLE. SET TABULATORS TO GIVE THE CORRECT ALIGNMENT OF EACH DIVISION OF INFORMATION. HOLD BACK ON SERVICE STAR AFTER TYPING. USE ASSN TYPEWRITER RIBBON.

Service Record Card.

This card folds about the line separating the two parts, the part here shown at the bottom becoming the front in the file. The service record form (here shown at top) is continued on the back and occupies the whole of that side. Scale and directions for typist are printed on the back on a detachable strip, which is here shown below the main card.

Winter Maintenance Cost Nearly $900,000 in Michigan

During the 1936-37 season the state highway department of Michigan spent nearly $900,000 in keeping 8,868 miles of state trunkline roads open to traffic during the winter. This is an average cost of $100 per mile for the entire state.

There was a decided contrast between costs in the Upper and Lower Peninsulas. The difference between northern and southern sections of the lower peninsula, however, was small. The average expenditure in the Upper Peninsula was $164 per mile while in northern counties of the lower peninsula the cost was $95 per mile and in the southern counties $80.

This difference in costs between the Upper and Lower Peninsula is explained by the unusually light snow-fall south of the Straits and the unusually heavy snow which fell in the Upper Peninsula. Although snowfall in the northern part of the lower peninsula is considerably heavier than in the southern counties, winter maintenance costs in the two sections are not far apart. This is due to the more extensive ice treatment necessary in the southern part of the state.

County road commissions in the northern part of the state were granted $200,000 for snow removal purposes by the last session of the legislature.

It is stated that all trunklines would again be included in the snow removal program next winter. The policy of sanding entire sections of icy highway will also be continued.

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NATIONAL PAVING BRICK ASSOCIATION, National Press Bldg., Washington, D. C.

ENGINEERING THE HIGHWAY FOR SAFETY

By R. E. TOMS
Chief of Division of Design, U. S. Bureau of Public Roads

THE highways of the United States as they exist at present represent the efforts of highway engineers to provide a large and continually increasing mileage of improvements to meet the demands of rapidly expanding motor vehicle usage. The necessity of spreading a practicable degree of improvement as quickly as possible with limited annual revenues over a large mileage of important highways—all in urgent need of improvement—forced a choice between long deferment of improvement on many of these highways, or of undertaking a more uniform up-building of the entire group.

Acceptance of the latter as the more feasible course has given the country a system of main highways improved in thousands of component sections each to a degree seen as imperative and practicable in point of cost at the time of its construction.

Changing Character of Vehicles Cause Problems

During this period of highway development the highway engineer was called upon to solve many problems of immediate concern that were created by the changing character of vehicles.

There was first the necessity for preventing the rapid disintegration of waterbound and gravel surface because of the loss of binder caused by the shearing effect of rubber tires in producing tractive effort.

Then there was the problem of providing road surfaces that were structurally strong enough to carry the loads moved over them. During and immediately following the world war a considerable mileage of improved highways were practically destroyed from the pounding of trucks equipped with solid rubber tires. Research undertaken by highway engineers in cooperation with tire manufacturers on the effect of impact on road surfaces largely was responsible for the development of the balloon tire which permitted an increase in the load carrying capacity of the vehicle without damage to the road structure.

From the researches also came the multiple axle feature of support which again added to the load capacity without damage to the road.

Construction technique also was concentrated upon the production of smooth riding surfaces to minimize the damaging impact from vehicle loads. The demand for the rapid extension of highway improvements focused attention upon the development of low cost dustless roads. Here again research and the application of knowledge pointed the way to practical solutions.

Practically all of these important problems had to do with the structural integrity of the road surface. It is no overstatement to say that these features of road design have been solved so that the highway engineer may proceed with confidence to design a road structure with assurance that it will be wholly adequate for the controlled wheel loads.

Geometric Features of Highway Design

In recent years there has been a sudden and marked increase in vehicle speed. This, combined with a greater usage of the vehicle itself, has caused an increasing number of highway fatalities each year. The average driver knows little and cares less about the strength of the pavement or the bearing power of the subsoil over which he rides. He accepts a structurally sound, smooth pavement surface as an accomplished fact, but he is very conscious of sudden curvature in the alignment or a lack of clearance between his vehicle and another and the speed at which it seems safe to travel.

All of these elements concern the geometric phase of highway design which in its broad sense deals with alignment, grades, curves, widths, intersections, etc.

To design or plan a utility intelligently, one must know the uses to which it will be subjected during its expected life. The essential elements that affect the adequate design of a highway are the speed, number, width, length and weight of the vehicles to be accommodated, and the safety, comfort and pleasure of travel to be afforded.

The width, length and weight of vehicles concern physical characteristics which largely have been controlled by legislation. The enforcement of legislative limits with respect to these characteristics generally is possible of accomplishment so that for any given set of conditions roadways may be provided with a reasonable degree of assurance that they will meet requirements. Construction technique has produced smooth highways that are comfortable to travel. Design and construction practice can produce highways that are as pleasing to the eye as they are comfortable to travel. Volume of traffic, speed and safety remain elements that must be appraised in design.

Volume is important only insofar as it affects congestion, the dangers that arise from congested highways and the number of traffic lanes required. The speed factor which largely has been disregarded in the past is a most important element in the design of safe highways. In effect it serves to control to a certain extent the width of traffic lane and to fix absolutely many of the geometric features of design, and it is upon the geometric features of design that safety of operation primarily depends.

Speed Factor Important Element in Design

What speed shall highways be designed for? Highways constructed 20 years ago were designed for 30 miles per hour; now even the slow drivers are moving at 40 miles per hour and speeds of 50 and 60 miles per hour are common rather than the exception. There is no doubt that the trend in all transportation is toward higher speeds. The highway engineer cannot afford to disregard this trend. It may be assumed, therefore, that highways in average topography to be reasonably adequate for present and future usage must be designed upon assumptions that will permit reasonably safe operation at speeds of 60 or 70 miles per hour.

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If the development of the vehicle should be curtailed or other undiscovered means found to fix a lower speed limit which could not be exceeded, there at least would be a very desirable factor of safety in such construction.

By designing for reasonably safe operation, higher rates of speed are not encouraged any more than on straight sections of highway. There is hardly a road of any considerable length in the flat and rolling sections of this country that does not have straight sections of varying lengths. A straight road with sufficient vision may be traveled at a speed limited only by the performance of the vehicle and the ability of the driver. The effect of designing for any given speed simply controls the maximum rate of curvature in the interest of safety without inviting the maximum speed.

Having determined upon the design speed it is encumbent upon the engineer to design all component parts of the highway so that it will be safe for travel at this speed. The inclusion of short sections of highway in which the curvature, sight distance or other details fall below the general standard constitutes a very serious fault.

If physical difficulties are encountered that necessitate the inclusion of substandard sections, then they must be adequately signed. An indication of the safe speed at such locations would be exceedingly helpful.

Engineering the Highway for Safety

Granting that ample provision has been made to insure the structural integrity of the roadway surface, engineering the highway for safety consists essentially of providing ample width of traffic lanes and sufficient clear vision.

You need more space to go fast than you do to go slow. You need greater clearance between vehicles. There is also a greater reluctance of drivers to travel at high speed near the edge of the pavement. The legal limit for overall width of trucks in most states is 8 ft. In order to provide adequate clearance we must provide traffic lanes not less than 11 ft. wide for highways carrying a considerable volume of truck traffic.

The necessity for ample clearance on bridges is equally important. For reasonably safe operation the distance between curbs on bridges should be not less than 4 feet and preferably 6 feet more than the width of the adjacent roadways. Short span bridges and culverts preferably should permit the entire roadway width including pavements, shoulders and guard rail. Drivers then will be given no sense of constriction and shoulders will be available for emergencies at all points on the highway other than major bridge locations.

Sight distance assumes great importance in highway safety. This is particularly true on our 2-lane highways, which constitute the bulk of our highway system. On a winding 2-lane road fast moving vehicles frequently overtake slower vehicles. Head-on collisions and side-swipe accidents may be reduced by constructing highways so that impatient and careless drivers would be encouraged to remain behind slow moving vehicles until they see a sufficient length of highway clear of opposing traffic for passing. Obviously, such encouragement is not afforded on a highway with mile after mile of inadequate sight distances. On the contrary, such a highway will tend to encourage even a patient and careful driver to take a chance, especially after remaining behind a slow moving vehicle for one curve after another without encountering opposing traffic and realizing that passing could have been accomplished.

While it is desirable to construct highways with adequate sight distance for safe passing at all places the limitations of topography and right of way may make it economically inadvisable to do so. It is not absolutely necessary that every horizontal and vertical curve be designed with adequate sight distance for safe passing, but if safe driving is to be encouraged it is vitally necessary that sections of highways, in which a driver will see enough of the highway to know whether or not it is safe to pass a slower moving vehicle, are not too far apart.

The Question of Sight Distances

On the basis of the foregoing it is evident that highways should be designed with two minimum sight distances in mind; one to accommodate the passing of motor vehicles with safety, and one to be considered as a non-passing minimum. A non-passing minimum sight distance should be encountered at all points on the highway. It should be at least long enough to permit a vehicle traveling at the assumed design speed of the highway to stop before reaching a stationary object in the same lane.

A passing minimum sight distance should be encountered at frequent intervals depending upon the topography, the assumed design speed of the highway and the probable density of traffic. The passing minimum sight distance should be sufficient in length to permit a vehicle to safely pass another vehicle, and preferably two vehicles, which are traveling at a speed of 10 or more miles per hour less than the assumed design speed of the highway in the face of opposing traffic traveling at the assumed design speed of the highway. The desire to pass vehicles traveling 10 miles an hour less than the assumed design speed is a reasonable one and should be satisfied.

There seems to be little advantage in increasing the minimum sight distance on existing highways or increasing the standard for minimum sight distances for new highways unless such increases provide the minimum sight distance sufficient for safe passing. This is particularly true on high speed highways.

Increasing sight distances by small amounts in excess of the non-passing minimums generally does not provide sight distances adequate for passing with safety and may make the highways more hazardous by encouraging vehicle operators to attempt to pass. It seems to be more advisable to concentrate expenditures on limited sections of the highways where topographic conditions make such changes feasible and improve these sections to secure sight distances adequate for passing with safety.

Non-Passing Sight Distances Discussed

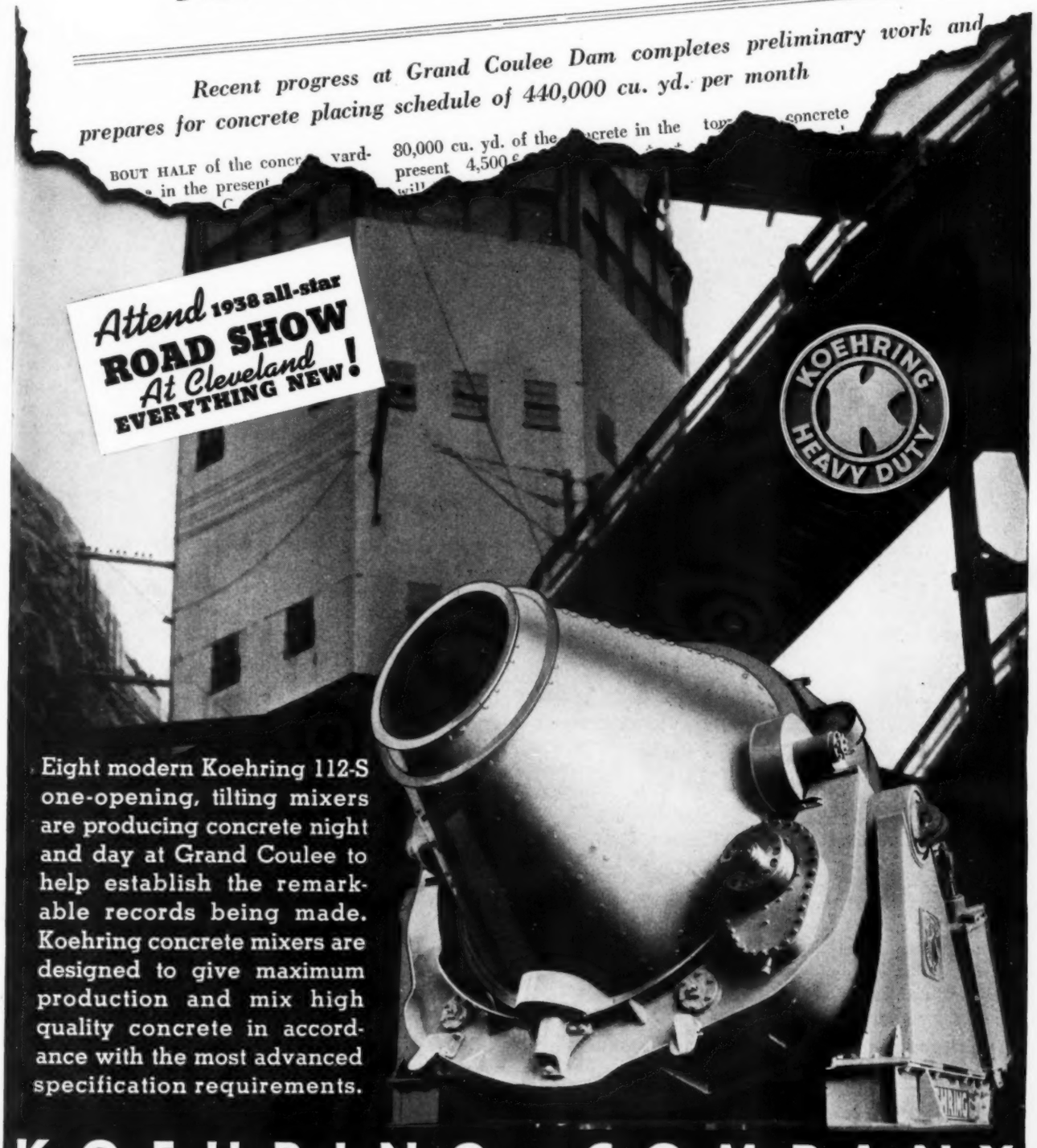
A brief discussion of non-passing sight distances may be worth while because of the belief that a considerable amount of data heretofore published on stopping distances at various speeds fails to take into consideration a very essential factor. Data heretofore published on stopping distances at various speeds have been predicated almost wholly on brake reaction time and brake resistance. A third element necessarily enters into this determination, that is, the time required for motor vehicle operators to come to a realization that the brakes must be applied. If we term this the perception time, it may be defined as the time elapsed from the moment a stationary object be-

July 15, 1937 · ENGINEERING NEWS-RECORD 101

New Record in Pouring Concrete

Recent progress at Grand Coulee Dam completes preliminary work and prepares for concrete placing schedule of 440,000 cu. yd. per month

BOUT HALF of the concr[illegible] yard- [illegible] in the present [illegible] C[illegible] 80,000 cu. yd. of the [illegible]crete in the [illegible] present 4,500 [illegible] [illegible] concrete



Eight modern Koehring 112-S one-opening, tilting mixers are producing concrete night and day at Grand Coulee to help establish the remarkable records being made. Koehring concrete mixers are designed to give maximum production and mix high quality concrete in accordance with the most advanced specification requirements.

comes visible to the instant the operator realizes that the object is stationary. Under certain conditions operators will come to this decision almost instantly. Among these conditions are disabled vehicles with persons on the ground adjacent thereto, flares at night and flashing lights at night. Under most other conditions the operator must learn by subconscious association with adjacent stationary objects such as walls, fences, trees, guard rail, etc., that the object is stationary. This takes time. The amount of this perception time will vary considerably, depending upon the natural rapidity with which the operator reacts, the optical ability of the operator, atmospheric visibility, type and condition of roadway, type, color and condition of vehicle, etc.

At higher speeds perception time may be less than at lower speeds due to the fact that drivers are more alert and due to the rapidity with which the stationary object apparently increases in size, but the total perception reaction time should not be decreased for higher speeds due to the greater danger involved. An allowance for perception time moreover compensates for momentary inattention on the part of the operator.

Perception time, being discriminative in character, probably is much greater than brake reaction time. For most motor vehicle operators it is assumed to be two seconds, although this may be changed considerably when and if exhaustive scientific tests are made. In determining non-passing sight distances for various assumed design speeds, they should be predicated upon a total of three seconds for perception and brake reaction time, and a braking distance obtained by using a rolling coefficient of friction of 0.4, which is about the lowest obtained in tests on clean wet pavements. On these assumptions, the suggested practical non-passing sight distance which should be encountered at all points on a highway is approximately ten times the assumed design speed of the highway.

Safe Passing Sight Distance Function of Speed

A safe passing sight distance is a function of the speed of the passing vehicle, the overtaken vehicle and the speed of the vehicle approaching from the opposite direction. If the differential in speed between the passing vehicle and the overtaken vehicle is large the safe passing distance is much less than when this differential is small. It increases if more than one vehicle is to be passed. A vehicle traveling 40 miles per hour, desiring to pass another vehicle traveling 30 miles per hour in the face of opposing traffic traveling at 40 miles per hour, will require 1,200 ft. of sight distance to pass one vehicle; 1,600 ft. to pass two vehicles, and 2,000 ft. to pass three vehicles. On the other hand, a vehicle traveling 60 miles an hour, desiring to pass a vehicle traveling 50 miles per hour with opposing traffic moving at 60 miles per hour will require 2,400 ft. of sight distance to pass one vehicle; 3,200 ft. to pass two vehicles, and 4,100 ft. to pass three vehicles.

These distances are based on reasonable assumptions. It is obvious that we must revise our conception of sight distance if we are to provide highways on which overtaken vehicles may be passed with safety.

Sight Distances at Curves and Grade Crossings

Horizontal curves which may be traveled safely at the assumed highway design speed frequently do not afford sufficient sight distance for a passing minimum. Except for comparatively flat gradients, it is impossible to obtain sight distance at the apex of a vertical curve sufficient to permit passing with safety at high speeds. It is practically a physical impossibility to provide highways with ample vision for safe passing at all points. There is much, however, that can be done to meet this situation that has not been done in the past. There has heretofore been but little conscious effort on the part of highway designers to provide safe passing sections at the speed at which highway travel moves at the present time. The fact that such sections are encountered on our existing highways has been due primarily to natural conditions encountered rather than to the efforts of the designer. Our highway designs in the future must be studied and worked out to avoid combinations of horizontal and vertical curvature which in effect, for mile after mile, deny the traveler an opportunity to pass.

Advantage must be taken of favorable topography at frequent intervals to provide safe passing sections, even if by so doing the design is made more costly. In rough topography favorable topography must be utilized to provide short lengths of widened road surface on which the slower moving vehicle would be directed to travel.

When two highways cross at grade and it is not desirable to subordinate the traffic on one to that on the other a driver on either highway should be able to see the intersection in time to stop his vehicle before reaching the intersection and he should see enough of the intersecting highway to enable him to judge whether or not he should brake. A driver should see the intersection at a distance at least equal to the safe stopping distance. The length of intersecting highway visible at that point should equal, at least, the product of the time required for the vehicle to stop and the assumed design speed of the intersecting highway. Where this is not possible traffic on one road should be subordinated to that of the other by appropriate signs.

Use of Stop and Slow Signs

When traffic on one road is subordinated to that of the other it may be done by stop or slow signs. The intersection should be visible to a driver on the preference road in sufficient time to enable him in an emergency to bring his vehicle to a stop before reaching the intersection. The same applies to the subordinate road except that warning signs sometimes may have to be resorted to in lieu of sufficient visibility. When traffic on the subordinate road is stopped at the intersection, enough of the preference road should be visible to allow the driver of a stopped vehicle to determine whether he may cross with safety.

Slow signs indicating the speed at which vehicles on the subordinate road may approach an intersection may be used where available sight distance is intermediate between that necessary for nonpreference road intersections and that necessary for stop sign intersections.

The speed on the slow sign should indicate that the point where visibility opens is far enough in advance of the intersection to enable a vehicle traveling at the signed speed to stop before reaching the intersection and that the length of intersecting highway visible at that point is equal to the product of the time it will take to stop and the assumed design speed of the intersecting highway. The slow sign should be placed far enough in advance of the

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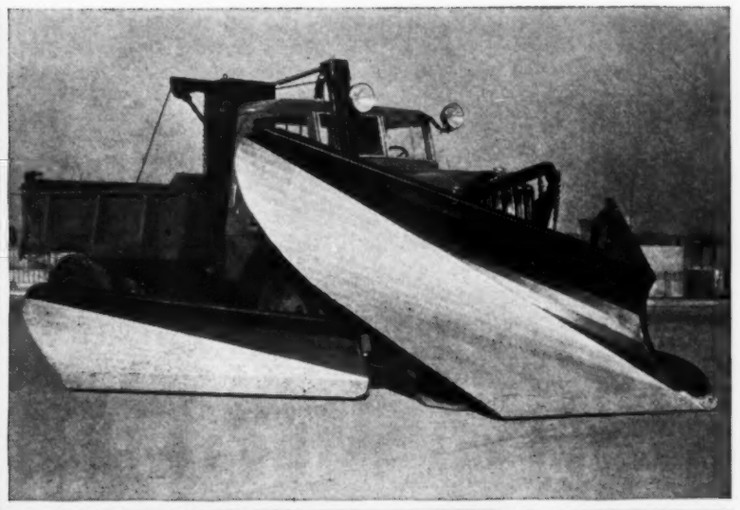

HAVE you ever seen a team of horses slipping on an icy pavement, unable to move a load that they could run away with under ordinary conditions? They have plenty of power but no traction.

The same thing often happens to snow removal equipment working after a heavy blizzard. A wheel loses traction and begins to spin, while its mate stops dead—all the power leaking out through the spinning wheel. In a rear wheel drive truck this is enough to stall it. In an ordinary four-wheel drive, two wheels, one front and one rear, losing traction at the same time will stall the truck.

The WALTER SNOW FIGHTER, on the other hand, can only be stalled if all four wheels lose traction at once. For the Walter is not merely a four-wheel drive—it is the only truck that has four-point positive drive. Correct differential action between all wheels, front and rear, right and left, is provided by three automatic locking or power proportioning differentials. These divide the power so that the wheels with least traction get the least and those with most traction the most power. This super-traction insures a positive drive on all four wheels on slippery ice and snow-covered roads.

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critical point to enable a vehicle traveling at the assumed design speed to slow down to the signed speed before reaching the critical point on the road.

Sight Distance and Safe Stopping Distance

At nonpreference intersections, sight distances less than those outlined above may not be extremely dangerous due to the possibility of a driver on one road slowing down to permit a vehicle on the intersecting road to clear the intersection before he aproaches it. The danger lies in the possibility of confusion between drivers. Both drivers may either slow down or maintain speed and thus approach the intersection simultaneously.

Danger also lies in the possibility of dense traffic or considerable turning traffic on one road making it necessary for traffic on the other road to stop. Sight distances less than stopping distance under such circumstances may end in disaster. No properly designed highway would have sight distance less than safe stopping distance at any point, intersection or otherwise, but inability to see an appreciable length of the intersecting highway may have as disastrous results as insufficient sight distance along the highway.

Where traffic increases to such an extent that safe passing sections lose their usefulness due to the fact that opposing lanes are generally occupied by traffic at the same time, congestion results and can only be relieved by providing additional traffic lanes. The three-lane highway is the product of economic necessity rather than a desirable objective. The extra traffic lane in theory is intended for passing purposes only. It is not always so used by traffic. It unquestionably is an invitation to traffic in opposing directions to compete for its use. Competition of this character is decidedly hazardous. Here again the ability to see is a fundamental requisite. The minimum sight distance for 3-lane construction should not be less than the minimum safe passing sight distance for 2-lane construction. For relatively high road speeds this sight distance is exceedingly large and difficult to obtain except in very easy topography.

Some Design Features of 4-Lane Highway

A 3-lane road with inadequate sight distance becomes nothing more than a wide 2-lane road. There is no doubt that the 3-lane highway increases traffic capacity, but unless topographic conditions are favorable every effort should be made to provide a 4-lane highway with traffic in opposing directions separated by a neutral strip or parkway.

On 4-lane highways a raised type of separation is decidedly preferable to a flush medium strip for the separation is decidedly preferable to a flush medium strip for the separation of traffic flow. The width of separation of opposing lanes may be from 4 to 6 ft., or from 12 to 30 or 40 ft. It is almost impossible to maintain grass or ground cover in healthy condition in areas less than 8 or 10 ft. in width. Narrow widths should be paved with some form of material to reduce maintenance to a minimum. If the separation is paved, it must not be of a width great enough to permit the parking of vehicles.

In addition to practically eliminating head-on collisions with opposing traffic, the 4-lane separated highway may be designed to decrease the hazards at grade intersections. On heavily traveled 4-lane roads it is almost impossible to obtain a sufficient break in traffic going in two directions to permit cross movement of vehicles without extreme danger without traffic control lights.

If the roadways are separated widely enough to provide a safety island, cross movement may be effected in two operations. A break in the flow of traffic in one direction permits a vehicle to be moved on to the pavement adjacent to the safety island, and the crossing is completed when there is a break in traffic in the opposite direction. For this purpose there should be a width of parkway of not less than 30 ft. between opposing lanes of traffic. Such construction also affords a high degree of flexibility in permitting recreational and pleasure traffic to utilize the openings provided for cross movement for turn around purposes.

Other than traffic lights, adequate traffic circles, and grade separation structures, divided roadways with ample width of parkway offer the safest means yet devised for the movement of traffic across heavily traveled roads. On 4-lane separated highways, it is not possible for vehicles to encroach on opposing traffic for passing so that the sight distance for safe operation may be limited to the non-passing or safe stopping distance for the designed speed.

Dangers of Unrestricted Access

We know definitey that the elimination of all possible points of collision make for safer highways. We know definitely that indiscriminate access from intersecting roads or driveways on which vision may be obscured to highways designed for high speeds constitutes an element of surprise that takes a large accident toll.

The ideal highway design, therefore, is one in which the highway will have four or more traffic lanes opposing traffic separated, no cross traffic at grade, no access except at predetermined points, and sidewalks provided for pedestrian traffic where needed.

To eliminate unrestricted access from abutting property, border roads would undoubtedly have to be provided in many cases to service adjacent property and serve to pick up local traffic and deliver it to points of predetermined access on the main highway. Where the development was sufficient to require the construction of border roads on each side of the main highway this type of construction in effect would require the paving of a manimum width of 80 ft. of roadway which together with the necessary grading and cost of grade separation structures would entail an expenditure of from $250,000 to $400,000 per mile. However desirable this type of improvement may be, it is not economically possible except on a very limited mileage of our state highway systems.

Only 2 Per Cent of State Highways Have Divided Construction

A properly constructed 2-lane highway is capable of carrying a traffic volume of from 4,000 to 6,000 vehicles per day without serious congestion. There can be no economic justification for attempting to provide 4-lane divided highways for traffic volumes less than can reasonably be accommodated on a 2-lane highway. Our state highway systems comprise about 324,000 miles of highways that represent the principal routes of highway travel in the United States. Figures released by the American Association of State Highway Officials show 4,655 miles of 3-lane construction, 2,576 miles of 4-lane construction and 201 miles of 6-lane construction.

Of the 2,777 miles of 4- and 6-lane widths only 565 miles were indicated as divided construction. In other words, after 20 years of effort in highway construction, less than 2 per cent of the state highway mileage has been improved to standards that are recognized as providing the maximum of safety and only an insignificant portion of this latter mileage has been developed to the point of separating all traffic at intersections by means of underpasses or overpasses.

To improve aproximately 5 per cent of the state highway mileage with four or more traffic lanes with opposing traffic separated, grades at intersecting highways separated, border roads provided and sidewalks constructed where needed, would involve an expenditure of approximatey $4,000,000,000. When these figures are considered we must admit that insofar as the future can be visualized approximately 95 per cent of the state highway mileage in this country may never progress in improvement beyond a 2-lane highway status.

There is no question but that the trend in highway design where four traffic lanes are justified by traffic volume, must be toward construction that will physically separate the flow of opposing traffic. In fact, there should be no further 4-lane highway construction undertaken in rural areas in which this principle of design is not incorporated.

While engineers generally know and understand the broad principles of highway design that effect the safety of travel, there are a number of blind spots that still need to be explored. Highway engineers generally are fully aware of the problems involved and the necessity for putting into practice the knowledge already available as well as the facts gained by investigation and research. That a concerted effort is being made to provide the greatest possible safety for highway travel in the construction of highways is evidenced by the fact that the American Association of State Highway Officials has designated the administrative officials of 12 of the leading state highway departments in the country to serve as a committee for the investigation and formulation of sound design policies having to do with highway safety. The Secretary of Agriculture recognizing the importance of this work has appointed the members of this committee as Consulting Highway Specialists to the Bureau of Public Roads in order to effectuate more rapidly the purposes of this committee. The program of the committee contemplates a thorough investigation and research of all phases of highway design, particularly with respect to geometric designs because of their influence upon traffic safety. The recommendations of this committee applied intelligently to highway design in the future will go a long way toward increasing the safety of highway travel insofar as it is possible to do so by adequate highway design.

It is significant that this committee at its first meeting unanimously decided that the subjects of highway classification, sight distances and the treatment of intersections were the most important for immediate consideration.

Acknowledgment—The foregoing is a paper presented at the Kansas City, Mo. Safety Congress of the National Safety Council.

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BRIDGE AND CULVERT CONTRACT IN 165-MILE ROAD.—The Canadian Department of Mines and Fisheries has awarded a contract for the construction of bridges and culverts on 165 miles of highway in Quebec to Armand Levesque, Roberval, Que.

Highway Research Board Expands Annual Meeting

In order to provide opportunity for needed discussion of many important road and transportation problems, the Seventeenth Annual Meeting of the Highway Research Board of the National Research Council is scheduled to be held in Washington, D. C., for four days commencing Tuesday, Nov. 30 through Dec. 3, instead of the two days that formerly were found sufficient. A large part of the time will be devoted to open departmental meetings on Economics, Design, Materials and Construction, Soils Investigations and Roadside Development.

All day Tuesday, Nov. 30, will be the open meeting of the Department of Soils Investigations. At the opening Board session on Wednesday morning papers and reports relating to soils and maintenance will be presented. Wednesday afternoon will be for open departmental meetings on Materials and Construction and Roadside Development. Thursday's meetings will include a general session in the morning on Finance, Materials and Construction and Roadside Development, and one in the afternoon on Highway Safety. Friday will be devoted to Design and Economics, a common general session in the morning and separate departmental meetings in the afternoon.

Research work on all phases of highway transportation has been very active during the past year, and reports of widespread activities will be reported upon and discussed by men who are doing notable research work.

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Contract Awarded for Research Station for Bureau of Public Roads

A contract for the construction of buildings for the research station of the U.S. Bureau of Public Roads at Abingdon, Va., was awarded Oct. 27 to the McCloskey Company of Philadelphia by the Division of Purchase, Sales, and Traffic of the Department of Agriculture. Construction must be completed within 18 months.

The McCloskey Company submitted the lowest bid of $957,500 for laboratory and shop buildings, a boiler house, mechanical and electrical equipment and an alarm system. The laboratories are to be erected on a 54-acre site overlooking the Potomac River on the George Washington Memorial Highway about two miles from the Highway Bridge. Completion of the buildings and the outdoor testing facilities for work such as has been carried on at the Arlington Experiment Station will give the Bureau facilities it has desired for many years—adequately equipped and housed laboratories with considerable area for outdoor tests on a permanent location. Permanent development has not been practicable in the past at Arlington as it has been known that the land occupied would eventually be taken for other government use.

The left wing of the group of buildings will house bituminous investigations and subgrade soil research. The right wing will be used for structural tests, concrete investigations and other non-bituminous investigations. A two-story bay in each of these wings will be available for high testing equipment such as may be used in impact studies and in bridge tests. Air conditioning is to be provided in those rooms where control of humidity and temperature will be of importance in making tests.

EDITORIAL

Block That Kick

DIVERSION of motor transportation revenues is still a serious problem of the highway industry. How much more than $200,000,000 is diverted to purposes unrelated to highways we do not know. The utter lack of uniform accounting systems for state and county highway income and expenditures makes it impossible to determine. This brings up the question of installation of uniform accounting systems then, as one of the first steps necessary in our effort to eliminate the diversion blood sucker.

At a recent meeting of the Highway Advisory Council of the American Road Builders' Association, action was taken toward recommending strengthening of Sec. 12 of the Hayden-Cartwright Act. The recommendation is to the effect that Sec. 12 be enforced and that it be amended to provide that federal aid funds withheld from a diversion state be placed in a special fund to be reapportioned to non-diversion states. With this we agree. We can see no justification for donating highway funds to state institution maintenance and upkeep, or to education. 'Twould be far more logical and equitable to return those moneys back to the taxpayer by a reduction of motor transportation revenue taxes. These other tubs should stand on their own bottoms. If funds are required for purposes for which diversion is now being employed, tax levies on the sources from which these projects equitably obtain their revenues should be adjusted to care for their increased requirements.

The American Revolutionary War was fought because taxation without representation (benefit of council) was imposed upon us. The American Diversion Fight must be forced because taxation without benefit is imposed.

This war is logically the responsibility of the American Road Builders' Association. Battle lines must be drawn on the next convening legislatures and all of us who derive all or part of our livelihoods from the highway industry must support the war proportionately. A $200,000,000 goal deserves an energetic campaign.

Highway funds are a political football in many of our states. Let's "Block That Kick."

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Economic Readjustment

THERE is no gainsaying the fact that we are emerging into a new order of social economy. It is a human being economy as contrasted to an economy of wealth and inanimate abstracts. Following is a contributed thought on the subject; we choose to withhold the author's name:

"It is to be observed that for a long period of time, profit has provided an accepted means of supporting certain unproductive members of the community, and of improving the income of those still active who have become possessed of property. There is no reason to question the propriety or the desirability of continuing this practice. It has served its purpose well. But in spite of this use of profit, there is nothing sacred about the rate at which it may be allowed to accrue, any more than there is about wage rates. Both are subject to any change which the general interests of the nation, as a whole, dictates. The objective is a readjustment in profit and in wages which will produce the greatest good for the nation as a whole.

"Under our social system, most men must work if they would eat. As long as we can produce all we wish to consume, the normal minimum wage should provide for the transfer of such a share of production as is required for a standard of living in decency and comfort. Also, as long as the satisfaction of our wants is a problem only of distribution—not at all of production—an opportunity to work and, therefore, to share in whatever goods there are to distribute is both necessary and reasonably simple of attainment, not simple in that it offers no complex problems and no new adjustments but simple in that it offers no unsurmountable difficulties. Finally, the urgent need for additional facilities—factories, railroads, power plants, etc.—having been met, additional capital invested in such things naturally has less value to the community as a whole than we have associated with such accumulations in the past. Inevitably, then, the adjustment of our current difficulties involves some rather important changes in our concepts of an industrialized nation. Its dominant objective becomes a greater degree of comfort for the masses. Not that this is altogether new. The advocates of the old system would claim the same objective. But in the future there must be this difference—that the good of the masses shall be treated as an independent objective rather than one conditioned on and secondary to the good of the few who are in nominal possession of the nation's wealth. This does not mean any failure to recognize the value of property, the need of accumulating it or the necessity of protecting it. It does mean that in the long run, the needs of human beings will be considered the dominant needs and that our industrial and other affairs will be attuned to a protection of human comfort, not only in the expansion of our present policy of protecting wage rates and in providing employment for all, but in adjusting profit to best serve the interests of the community as a whole.

"It is to be observed that this will deprive the few who hold large interests of nothing of real value. Their interests remain and their influence as valuable leaders is preserved intact. Only in one respect does it appear that they must face a radical change. Management—real management—must replace manipulation and wage shaving. The man who is wealthy today because he shaved wages more successfully than his neighbor is not much to be criticized. The game was being played that way and he played it well. But his day is about over. The future affords no place for that type of management. The value of profit to the race as a whole does not justify it. So wage shaving as a means of producing profit is out, and it will stay out. The manager of tomorrow must be a manager in fact—a man who can claim a profit on the honorable basis of work skillfully handled and of undertakings honestly accomplished through labor that is justly compensated for its efforts. The best interests of the nation and the best interests of the individuals of which it is composed can be permanently satisfied in no other way."

NEW EQUIPMENT AND MATERIALS

New 12-Yd. Quarry Model Truck

The Hug Co., Highland, Ill., has announced the addition of the Model 99S to its present line of quarry models. The Model 99S is built along the same lines as the Model 99 which has proven to be a very successful quarry unit.

The 99S is available with gas or Diesel power, has a maximum payload capacity of 40,000 to 44,000 lbs. and is designed to handle power hoist bodies up to 12 yard capacities. The standard engine is the Buda GF-638 gas engine with the Cummins HB-6 Diesel offered as optional equipment. Transmissions include a 4-speed unit and 3-speed auxiliary, giving a total of 12 speeds forward and 3 speeds reverse.

The rear axle is the double reduction dual-drive type, equipped with equalizing beams and torque rods to properly distribute the load over both axles and keep them in the same parallel plane. Tires are 12.75 x 20, single front and dual rear,

Hug 12yd. Quarry Model

and air brakes on all wheels are standard equipment. Standard equipment also includes an all welded Hug steel cab and the unit is offered with various types of side and rear dumping bodies and hoists.

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New FWD Truck for Highway Maintenance Work

The Model HG, newest of the FWD four-wheel drive line of trucks, and designed especially for highway maintenance work, has just been announced by the Four Wheel Drive Auto Co. of Clintonville, Wis., and Kitchener, Ont., Canada.

Attractively streamlined within the bounds of practicability, the new unit is of rugged construction, and built to withstand grueling operating conditions encountered in maintenance work.

Among the features of the new maintainer unit is the construction of the patented FWD transfer case for this particular model. The case has been built so that a clearance of 23 in. under the driving mechanism permits the installation of an underbody scraper, or other underbody maintenance equipment.

Speed in high gear, with engine governed at 2,500 rpm, and standard tires as equipment, can reach 37.4 miles per hour, according to FWD engineers. Five speeds forward, and one reverse, and a transmission of selective sliding gear type are other features.

Model HG Four Wheel Drive Truck

The unit has a rated capacity of two tons, and a gross rating of 16,000 lbs. The chassis weight (dry weight) is 6,530 lbs. with cab included. A wheelbase of 156 in. is standard. With bore and stroke of 4⅛ in. x 4¼ in., and a piston displacement of 381 cu. in. the 6-cylinder FWD 6-MK motor develops 85 HP at 2,500 rpm.

The center differential is of the design exclusive with trucks of FWD manufacture. This device, of conventional bevel gear type, compensates for the difference in distance traveled between the front and rear axles. The front axle is of the full floating, bevel gear type, with ball and socket in the front axle housing, enclosing universal joints. The rear axle is also a full floating, bevel gear type.

Brakes include a 4-wheel hydraulic set, operated by a vacuum booster, and a parking set, of the external contracting type, operating on the transmission, with braking action on all four wheels. The wheels are the ventilated disc, Budd type.

Tires are 7.50 x 20 in., with singles mounted on front wheels, and duals, rear.

The electrical equipment has a six-volt, starting and lighting system, dash light, tail light, headlights mounted on the cowl for efficient night maintenance, and electric horn.

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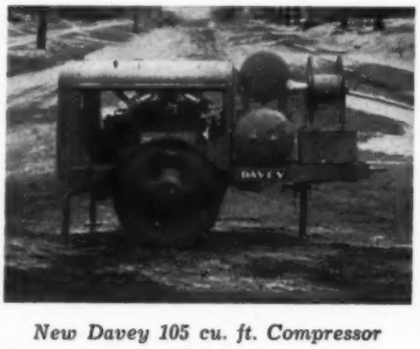
New 105 Cu. Ft. Compressor

A new model in the line of the Davey Compressor Co., Kent, O., is a 105 cu. ft. side-by-side trailer. "Compactness" is the outstanding characteristic of this unit which is 62 in. high, 65 in. wide and 114 in. long. It is claimed to be especially adapted for use where a high degree of portability is essential and can be towed



New Davey 105 cu. ft. Compressor

behind a car with ease. Pneumatic tires are standard equipment. It is available in either single or two stage design with no difference in price.

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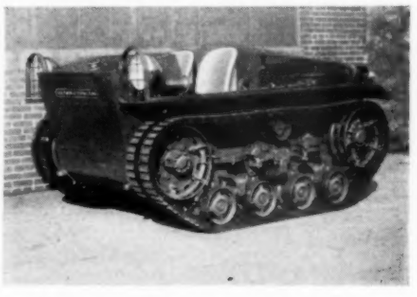
New Crawler Tractor Has Rubber Track

A new track laying tractor having a rubber track and stated to be capable of road speeds of 25 miles an hour or better has been announced by the Marmon-Herrington Co., Indianapolis, Ind.

The new tractor utilizes the B. F. Goodrich new type of track with Marmon-Herrington patented suspension. The special track is a continuous band of rubber, smooth on the inner surface and with adequate traction lugs on the outer surface. It is claimed it cannot stretch or lost its shape because it has a core of from 20 to 30 endless, flexible wire steel cables gripped at intervals by the track guide and drive lugs. The drive sprockets impart their power directly to the cables and the rubber is used only as a cushioning medium and not to transmit power.

The unit has ease of operation and excellent riding quality. Road shocks are cushioned by an unusual and exclusive



New Marmon-Herrington Tractor

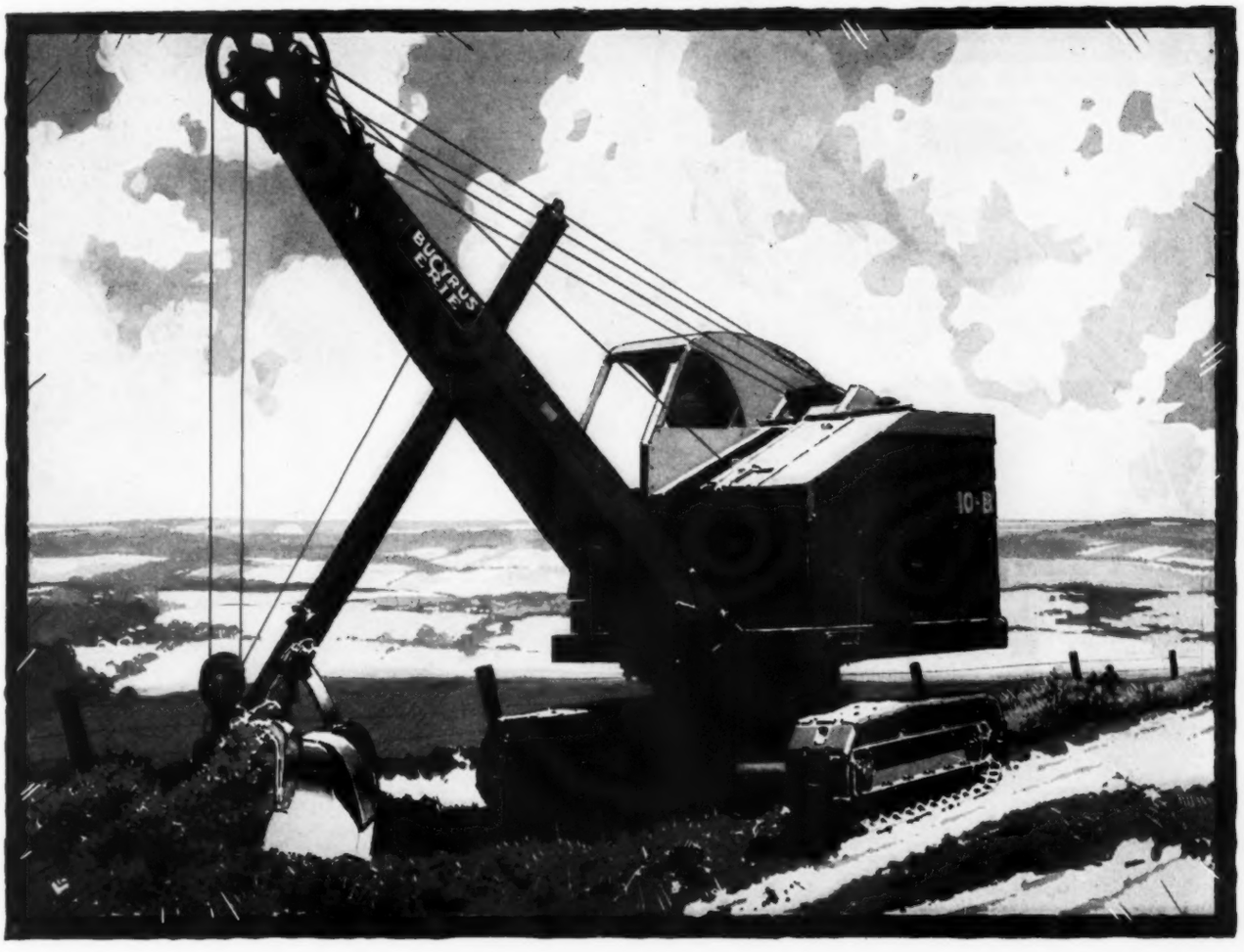
Marmon-Herrington spring suspension which is self-dampening and which eliminates rocking, pitching and galloping. Operation has been perfected to make finger-tip control adequate and the rolling resistance of the unit has been reduced to the point where a brake is necessary.

Steering clutches are a new type, fully air-cooled and operated mechanically with an auxiliary servo-booster system.

It is claimed the tractor can be pivot turned either from a standing position or from the highest forward speed in perfect safety. Its center of gravity is so low that the unit can be turned on the face of any hill it will climb and while it may slip sideways it does not turn over. Special welded steel hull is watertight, allowing operation in more than 36 in. of water.

Servicing the tractor has been made unusually easy through an extensive use of standard automotive parts. Each part, including the engine is easily accessible.

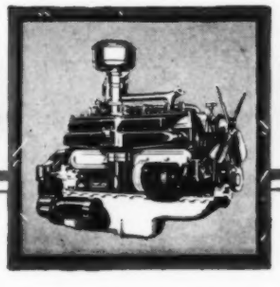
HIGHWAYS BUILT AND MAINTAINED WITH HERCULES POWER



Power shovels such as the Bucyrus-Erie 10-B used by the Stephenson County, Illinois, Highway Department are only one of the many kinds of road-building and road-maintenance machinery powered by Hercules Engines. Both contractors and highway departments have long known that the name Hercules means efficient, economical, dependable power for mixers, ditchers, pavers, rollers, scarifiers, scrapers, snow plows, sweepers and other equipment to do every kind of highway job. The broad range of Hercules Engines and power units—both gasoline and Diesel—includes a type and model applicable to powered machinery in every phase of industry. Hercules' leadership is equally pronounced in automotive, agricultural, oil field, marine and industrial fields. Hercules has been building heavy-duty engines exclusively for more than twenty years.

HERCULES MOTORS CORPORATION, CANTON, OHIO

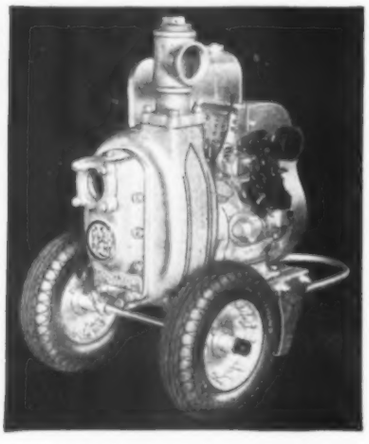
America's Foremost Engine Manufacturer • Power Plants from 4 to 200 H. P.

HERCULES  **ENGINES**

New Self Priming Pumps

A line of self priming pumps has been added to the line of contractors' equipment of the Construction Machinery Co., Waterloo, Ia. According to the announcement CMC "Dual Prime" pumps are modernly engineered in accordance with CMC practice of bringing the contractor speed in operation and portability plus ruggedness to stand the "gaff" of construction operations. Compactness is another feature recommending these units to the contractor.

Several interesting features of CMC pumps are mentioned in the announcement. Dual priming jets with simplified recirculation control, and highly efficient impeller and volute assures maximum performance. The three blade trash type impeller, the CMC "Permaseal," flanged



The 15M Pump

suction and discharge connections, adjustable impeller, and close coupled construction, are additional features.

This new line of pumps will be available in all standard sizes from 2 in. to 6 in. inclusive. In addition, there will be a light weight model. Literature and complete information may be secured by request from Construction Machinery Co., Waterloo, Ia.

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New Traffic Line Marker

A new traffic line marker has been placed on the market by the Lewis Manufacturing Co., Decatur, Ill.

The machine has a high-speed pressure fan, driven by a small gasoline motor. A gear type pump delivers the paint from the tank to the air nozzle, where a powerful blast of air from the fan breaks the paint into a mist and drives it forcibly onto the pavement. This is stated to not only bond the paint to the pavement, but the air blast also clears dirt and other loose material from the surface to be painted, thereby laying the paint on the clean surface. The machine is easily operated by one man and it stated it will lay a line at an average speed of from two to four miles per hour, the line being from 3 to 8 in. in width, as desired. Short lines to the curb are laid as easily as long lines.

Lewis Traffic Line Marker

The shoes are so set that these lines can be laid up to the curb.

The Lewis Manufacturing Co. also has introduced a portable electric automatic traffic signal, which provides a safe, efficient and inexpensive method of controlling the traffic adjacent to schools. Being portable, it is removed at such times as not in use, and leaves the street unimpeded for traffic.

The General Iron & Steel Corp., 109 Crosby St., New York City, are exclusive eastern distributors for the Lewis Mfg. Co.

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Skip-Pipe for Sub-drainage and Underdrains

Skip-pipe, a sloping cradle invert pipe for sub-drainage or under drains has been announced by the Dimmick-Mosher Products Company, 120 Boylston St., Boston, Mass. The pipe is a cast iron product. The lower half of the drain is a true semi-circular section of cast iron pipe. Super imposed on the section and cast integral is a cradle invert, which slopes from bell end to spigot end. The drain operates without head or hydrostatic pressure. No head is built up.

The pipe is the result of extensive research and tests by experienced engineers thoroughly familiar with the problems of sub-drainage of highways, railroads (freight yards and right-of-way), airports, ball parks, golf courses, recreation fields and playgrounds, and, in fact, any open area where complete and quick drainage is necessary.

The method of laying the pipe is as follows: After the pipe has been laid and has received the inspection and approval of the engineer, clean gravel, or broken stone filling, all passing a 3 in. sieve and retained on a ¾ in. sieve (unless otherwise stated on the plans in which case the plans shall govern) is placed carefully, so as not to displace the pipe or joint covering around and over the pipe to within 12 in. of the finished ground surface. The upper 12 in. of the trench is then filled with suitable material of either the porous or impervious type as shown on the plans or as directed by the engineer. Stone and any other surface filling shown on the plans is tamped firmly.

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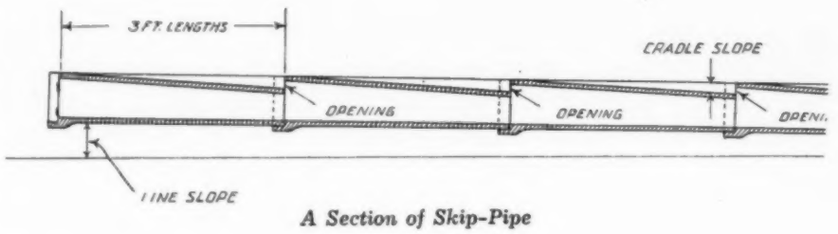
New Federal Trucks

Twelve new Federal Truck models are being introduced for 1938 by Federal Motor Tank Co. of Detroit. The new models, ranging from ¾-ton to 5-ton capacities, round out Federal's 1938 line of 29 models, including conventional and cab-over-engine types, which embrace virtually every commercial transportation requirement.

The new models are powered by a wide range of Hercules truck engines designed exclusively for commercial vehicle use. Features common to all 6-cylinder engines powering Federal trucks are 2½-in. seven-bearing crack shafts with electrically hardened bearing surfaces, large full length water jackets, positive gear driven water pumps, force feed lubrication, wide face, silent timing gears, air-cleaners, oil filters and governors. An oil bath air-cleaner is standard on all models with tonnage capacity of 2-3½-tons and upward.

Four-speed transmissions are standard on all models under 3-4½-ton capacity. Models of 3-4½-ton capacity and over have five-speed transmission. The latter equipment is optional on all models of 1½-2½-ton ratings and over.

Large four-wheel hydraulic brakes are standard equipment throughout the Federal line. All units of 2-3½-ton capacity and over are equipped with vacuum power boosters. Rear axles of all new models are Timken full-floating bevel-drive type. Two-speed axles are available as special equipment. Oversize "fish belly" type frames are used in all models. Other important mechanical features are roller bearing universal joints, fore shackled front springs and rubber bushed spring eyes requiring no lubrication. Cast-steel wheels are standard on all models.



A Section of Skip-Pipe

New 4-Cylinder Diesel Series

As a further step in its program to make available a complete line of high-speed Diesel engines, paralleling in performance and installation dimensions Hercules gasoline engines of similar displacement, Hercules Motors Corporation, Canton, O., has announced the series "Doo" 4-cylinder Diesels.

Of neat, compact design, the new "Doo" series has been developed particularly for use in commercial vehicles of smaller and more popular sizes as well as for a wide variety of industrial, agricultural, oil field and marine applications. Three models of the new series have been produced. The smallest, the "Doob" has a bore of 3¾ in. and a stroke of 4½ in. with the total piston displacement of 198.8 cu. in. The "Dooc" has a bore of 4 in. and a 4½ in. stroke with 226.2 cu. in. displacement and the "Dood" has a 4¼ in. bore and 4½ in. stroke with a 255 cu. in. displacement.

The "Doob" is rated at 62 H.P. and the "Dooc" at 70 H.P. at an engine speed of 2600 R.P.M. At 1600 R.P.M. the "Dood" develops 56.5 H.P.

Engines of the new series are interchangeable from an installation standpoint with the Hercules "00" series of gasoline engines, allowing manufacturers to supply either gasoline or Diesel engines in their equipment without any mounting complications. This follows Hercules' practice in the three larger series of Diesel engines and their companion gasoline models.

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WITH THE MANUFACTURERS

Baker Equipment Engineering Co. Moves Into New Plant

The Baker Equipment Engineering Co., Summit and Rockbridge Sts., Richmond, Va., has moved into its new plant at Richmond. The plant has 65,000 sq. ft. of floor space. The company manufactures Baker trailers, commercial bodies and public utilities bodies. It also is distributors for the following:

Gar Wood dump bodies and hoists, Gar Wood gasoline tanks, Wayne all-steel bus bodies, Mead-Morrison winches and derricks, Timken 3rd axle units, Timken 2-speed axles, Timken trailer axles, Utility 3rd axle units, Olson wheelbase extensions, Watson-Brown-Lipe transmissions, Orrville sleeper cabs, Universal high-lift coal bodies, power take-offs and drives, Mason commercial bodies, Mifflinburg commercial bodies, Vel-Vac power booster equipment, helper springs.

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A. T. Cox Made Manager of Lincoln Tri-Cities Office

The Lincoln Electric Co., manufacturers of arc welding equipment, Cleveland, O., announces the appointment of Arthur T. Cox., Jr., as manager of its Tri-Cities welding sales-engineering office, located at Moline, Ill., effective Nov. 1. Mr. Cox formerly worked in the company's Chicago office. The Tri-Cities office is located at 1205-09 Fourth Ave., where various models of the new "Shield-Arc S.A.E." welders are on display together with latest developments in arc welding electrodes and supplies. Mr. Cox is succeeding Mr. J. B. Flock, who is taking a year's leave of absence.

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J. A. Schallenberg, Assistant Comptroller of Worthington

Effective Oct. 1, 1937, Mr. J. A. Schallenberg is appointed Assistant Comptroller of Worthington Pump and Machinery Corporation, Harrison, N. J. Mr. Schallenberg has served the Corporation in various capacities in the Treasury and Accounting Departments during the past twenty years and is exceptionally well qualified for this position. Since 1930, he has served as Special Representative of the Treasury and Accounting Departments, with headquarters in Paris, France, and while the affairs of the foreign subsidiary companies will continue to have his attention, the major portion of his time will now be devoted to the Parent Corporation.

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New Hypressure Jenny Distributors

The Homestead Valve Manufacturing Co., Inc., Corapolis, Pa., has appointed the following as distributors of Hypressure Jenny, the steam vapor spray cleaner:

The Gibson Co., 433 No. Capital Ave., Indianapolis, Ind.; The Keyes Co., 115 West 5th Street, East Liverpool, O.; Minneapolis Iron Stores Co., 512 No. Washington Ave., Minneapolis, Minn.; Dyke Motor Supply of Akron, 372 South Broadway, Akron, O.; Canton Hardware Co., 122 Third Street, N.W., Canton, O.

New Plant at Richmond, Va., of Baker Equipment Engineering Co.

McLaughlin Appointed District Manager Davey Compressor Co.

Appointment of L. J. McLaughlin as Mid-Western District Manager of the Davey Compressor Co., Inc., Kent, O., was announced recently by President Paul H. Davey. McLaughlin, who brings a background of more than 20 years equipment experience to his new position, was formerly sales manager of the Hug Truck Co. Prior to that he served in a similar capacity with the Red Star Products Co., Inc.

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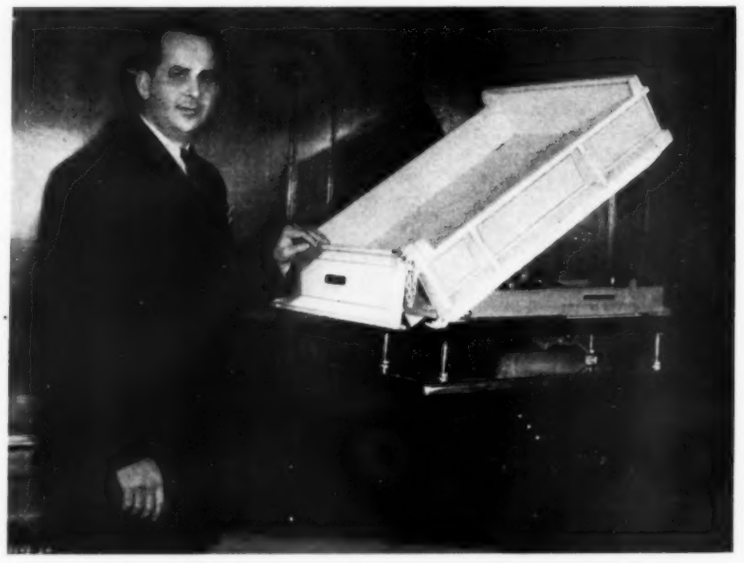
Gar Wood Features Operating Miniatures and Truck Equipment at Newark Show

Gar Wood Industries, Inc., of Detroit, Mich., displayed a representative line of motor truck equipment which includes Gar Wood hydraulic hoists and bodies, winches, cranes, polo derricks, and streamlined tanks, at their exhibit at the Fourth Annual National Motor Truck Show, Center Market Building, Newark, N. J., Nov. 6 to 12.

Two, hydraulically-operating miniatures of Gar Wood hoist and dump-truck body assemblies were featured. The two miniatures were used to demonstrate the operating principle and sales features of these Gar Wood products. One of the miniatures showed the heavy-duty, T44 Boulder Dam type of body with dual telescopic hoists; the other miniature consisted of a C12 body and D6 hoist and has a specially-designed glass cylinder supplanting the steel cylinder, for observation purposes.



W. H. Hammond, Sales Manager Hoist and Body Division of Gar Wood Industries, Inc., and a Miniature of the Hydraulic Hoist and Dump Body Assembly.

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Sullivan Appoints Limont Manager Compressor Division

Alexander W. Limont, Jr., has been appointed manager of the Compressor Division of Sullivan Machinery Co. at Michigan City, Ind. Mr. Limont has broad knowledge and experience in compressor problems. He has been responsible for the development and application of compressors for many special uses and has had exceptional opportunity for judging them from the users' point of view. He comes to the Sullivan Machinery Co. from the E. I. Dupont de Nemours organization with whom he has been associated for the past nine years. Mr. Limont was previously connected with the Norwalk Iron Works of Norfolk, Conn. as chief engineer and later with the Ingersoll Rand Co. He is a member of the A.S.M.E. Committee which establishes the codes for Unfired Pressure and External Pressure Vessels.

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W. L. Rickard Dies

William L. Rickard, President of Rickard & Co., Inc., Advertising Agency, New York, N.Y., died Oct. 5.

Ransome Appoints Representative in Oregon

Western Steel & Equipment Corp., 734 N.E. 55th St., Portland, Ore., has just been appointed as District Representative for the entire line of Ransome Concrete Machinery Co., in the Oregon territory.

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General Iron & Steel Corp., Eastern Distributors for Lewis Mfg. Co.

The General Iron & Steel Corp., Wm. Appleby, President, 109 Crosby St., New York, N. Y., has been appointed exclusive eastern distributors for the line traffic marking machines and street and traffic safety equipment of the Lewis Manufacturing Co., Decatur, Ill.

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McNutt Joins Bert S. Gittins Advertising Agency

George C. McNutt has joined Bert S. Gittins, Advertising, Milwaukee, Wis., to help handle the agency's industrial accounts. For the past 2½ years he was advertising and sales promotion manager of R. G. LeTourneau, Inc., Peoria, Ill., manufacturer of heavy construction equipment. Previous to that, Mr. McNutt conducted his own advertising agency and did free lance work on the Pacific Coast for a number of road machinery manufacturers and construction magazines.

Quick Job of Moving Harvester's General Offices

One of the largest moving jobs in Chicago in ten years took place the week-end of Oct. 8 to 10 in the transfer of the International Harvester Co. general offices from 606 South Michigan Ave., Chicago, to a 23-story building at 180 North Michigan. The work was begun after office hours Friday, October 8, and was completed by 1 P.M. the following Sunday. More than 300 van loads of furniture and equipment for an office personnel of approximately 1,000 were moved during Friday and Saturday nights and Sunday forenoon.

The new Harvester quarters, at the southwest corner of Michigan Ave. and Lake St., are in what has been known as the Lake-Michigan Building but which has been renamed the Harvester Building.

Studied and planned for months, the job of moving the Company's equipment in so short a time required a crew of 100 men from the Werner Bros.-Kennelly Company, the moving contractors, and a detail of 60 from the Harvester Company. For an undertaking of its type and magnitude, it probably set a record in time conservation.

Erected in 1927, the new Harvester Building was bought by the Harvester Company in February, 1936, and within the last several months has been extensively remodeled inside for most efficient utilization of floor space and for promoting the comfort and guarding the health of Harvester employes.

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Waukesha Appoints Schulze Assistant Sales Manager

Appointment of F. C. Schulze to the post of assistant sales manager has been announced by the Waukesha Motor Co., Waukesha, Wis., as a part of their sales department expansion program.

F. C. Schulze

This appointment is the culmination of ten years of thorough ground work in most every department of the company. Mr. Schulze became associated with Waukesha in 1928, and began his training in the plant, spending a few months on each of several machine shop and assembly line jobs. His next step was to the purchasing department which experience is of much value today in enabling him to understand client problems. And his intimate knowledge of plant procedure comes from the several years spent in plant maintenance as assistant to the superintendent of this activity.

Mr. Schulze joined the sales department four years ago, and since then he has been active in sales direction and organization. Besides his inside training, he has spent some time in the field with users of Waukesha engines.

Mr. Schulze is a native of Beaver Dam, Wis., and received his early schooling in that city. He attended Carroll College, Waukesha, where he was active in athletics, receiving all state honors for three consecutive years in both football and basketball. He came to Waukesha Motor Co. shortly after his graduation, and has been with them continuously since that time.

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Marmon-Herrington Purchases New Plant

Purchase of the modern factory buildings and 16-acre tract of Duesenberg, Inc., at West Washington and South Harding Sts. in Indianapolis, Ind., as the new home for the Marmon-Herrington Company, manufacturers of all-wheel-drive motor vehicles, has just been announced by Walter C. Marmon, chairman of the board of directors.

The company will move from its present location in the old Nordyke-Marmon plant at York street and Kentucky Avenue and plans to be in full production of Marmon-Herrington products in its new quarters by Dec. 1. There will be no interruption of operations during the removal period, however.

The property is excellently located for manufacturing, being at the junction of the Big Four and Belt railroads. There are two large brick and structural steel factory buildings and a large 2-story, fireproof office building on West Washington St. The assembly line of the Marmon-Herrington Co. will occupy the building frontage on West Washington St. and the concern's machine shop and experimental laboratories will be in the building on South Harding St.

Additions will be constructed to meet the requirements of the new owner as needed. The Marmon-Herrington Co. will take over machinery and equipment now in the plants besides installing all its present equipment in the new location.

▼

Death Takes P. C. Brooks, Fairbanks-Morse Executive

Percy C. Brooks, former executive vice-president of Fairbanks, Morse & Co., Chicago, Ill., died at his home in Chicago Oct. 15 after a lingering illness of about a year. He was 65 years old.

Mr. Brooks started his business career with the Atlantic Machine Works following his graduation from the Georgia School of Technology in 1891. In 1898 he began nearly 40 years' association with Fairbanks, Morse & Co., as assistant to the general manager at Beliot, Wis. Sharp attention to details and a keen power of analysis won him prompt and continuous advancement. He became manager of the Beloit plant, and when Canadian Fairbanks-Morse was organized and a large factory built at Toronto in 1905 he was appointed general manager. Four years later he was made vice-president of the Canadian enterprise.

At the outbreak of the war in 1914, Mr. Brooks converted his factory into a munition works for the British Government. Using a system of continuous operation on six-hour shifts, employing over 6,000 men and women, he built up an organization so skilled and thorough and a plan of operation so intensive that his plant produced over five million shells (3.3 and 8 in. diameter)—many more than any other factory in the United States or Canada. His efforts were rewarded by a visit and compliments from British Royalty.

After the war Mr. Brooks was transferred to St. Johnsbury, Vt., as vice-president and general manager of E. & T. Fairbanks Co. Later he was made president of this company, a position he held for about ten years. He was president also of E. & T. Fairbanks & Co., Ltd., Canada, and had supervision of the company's plant at East Moline, Ill. His was the task of supervising the acquiring of E. & T. Fairbanks Co. assets by Fairbanks, Morse & Co. In 1930 Mr. Brooks was transferred to Chicago as executive vice-president, a position he relinquished a few months before his death.

Despite the many responsibilities placed upon him, he managed to pursue with energy his favorite hobbies, golf and music.

▼

E. O. Jones Appointed Safety Director For Ethyl Gasoline

Ellis O. Jones, Jr., of New York has been appointed to direct the safety activity of the Ethyl Gasoline Corporation on the West Coast with headquarters in Los Angeles. His field will be co-extensive with the Corporation's Los Angeles Division, which embraces California, Arizona, Idaho, Nevada, Oregon, Utah and Washington, and of which S. M. Wagner is manager. Mr. Jones has been with the Ethyl Corporation since 1932, serving as field representative in Western New York and New Jersey. Latterly he has been in charge of safety work in the New York Division under the direction of the Corporation's Safety Committee, of which O. B. Lewis is chairman. He has been active in carrying out the safety program of the American Petroleum Institute and of the Philadelphia Safety Engineers Club. A graduate of Massachusetts Institute of Technology in the class of 1924, Mr. Jones was formerly connected with the Consumers Power Company of Jackson, Mich., and, as assistant sales manager, with the Bonney-Floyd Co. of Columbus, O.

▼

Lincoln Electric Appoints Maichle Manager of Detroit Office

Announcement is received from The Lincoln Electric Co., manufacturers of arc welding equipment, Cleveland, O., of the appointment of F. M. Maichle as manager of its Detroit arc welding sales-engineering office, effective October. Until his new appointment, Mr. Maichle was manager of the company's Pittsburgh office.

Mr. Maichle studied at the United

States Naval Academy and from 1916 to 1928 served the United States government as a naval officer. He was a member of the 1920 Olympic wrestling team and holds the rank of Lieutenant Commander in the United States Naval Reserve.

Prior to starting work for The Lincoln Electric Co., Mr. Maichle was sales engineer for three years for a steel company and sales manager 3½ years for a manufacturer of stoking machinery. He brings to his new position, extensive experience assisting industrial concerns in the application and use of electric welding. At the Detroit office, 10228 Woodward Ave., Mr. Maichle will be assisted by C. H. Buckmaster, J. F. Cunningham, N. B. Gilliland, T. A. Steel and F. E. Boucher.

▼

NEW LITERATURE

Tests of Steel Columns—Bulletin No. 292, "Tests of Steel Columns," by Wilbur M. Wilson, which has just been issued by the Engineering Experiment Station of the University of Illinois, contains a report of a series of tests of steel columns of different types that have been made from time to time during the past six years. The specimens and the funds with which to meet the direct expenses of the investigation were contributed by the Chicago Bridge and Iron Company.

The columns were grouped as follows: Thin cylindrical shells, laced channels, and angle struts.

The investigation of thin cylindrical shells as columns was fairly comprehensive. The results obtained indicate that, for cylindrical shells fabricated with butt joints, straight and free from other geometrical imperfections, the "wrinkling stress" (the ultimate load divided by the area of a transverse section) for plates ¼ in. or more in thickness will be equal, approximately, to the yield point of the material, if the latter is 33,000 lb. per sq. in. or less, and if the ratio t/R is 0.015 or more, where t is the thickness of the shell wall (plate) and R is the mean radius of the shell.

The usual design formulas for the more conventional types of steel columns would appear to be applicable to cylindrical shells fabricated with butt welds and loaded as columns if the plate is ¼ in. or more in thickness, and if the ratio t/R is 0.015 or more.

While the investigation of the other types of columns tested was less comprehensive, the tests of four laced-channel struts apparently indicated that the light lacing provided was effective in making the two channels act as a unit, and that the unit stress developed by the struts, which had an L/r ratio of 119, was 84 per cent of the yield-point strength of the material.

Until March 15, 1938, or until the supply available for free distribution is exhausted, copies of Bulletin No. 292 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Ill.

New Pressed Steel Frame Mounted Pumps—A new line of pressed steel frame mounted ball-bearing centrifugal pumps is described in recent literature issued by Worthington Pump and Machinery Corporation, Harrison, N. J. Available for belt or motor drive, these type CF pumps are suitable for handling capacities from 10 g.p.m. to 300 g.p.m., at heads from 10 ft. to 120 ft. Interesting sectional views of these pumps included in the bulletins illustrate the new YU type pressed steel frame. Equipped with two grease-lubricated ball bearings, these modern single-stage units should serve a wide range of uses. Bulletin W-310-B7 covers the belt-driven units and W-310-B8, the motor-driven.

Soil Stabilization—The American Road Builders' Association has recently issued, as Bulletin No. 47, a symposium on soil stabilization, containing reports by leading authorities in this field of highway work. Subjects covered in the bulletin, and their authors, include: "Role of Soil Binders and Aggregates in Soil Stabilization", by C. A. Hogentogler, Senior Highway Engineer, and James A. Kelley, Junior Highway Engineer, U. S. Bureau of Public Roads, Washington, D. C.; "Road Stabilization", by L. L. Allen, Assistant Maintenance Engineer, Minnesota State Highway Department, St. Paul, Minn.; "Stabilization with Aggregates, Binder-Soil and Calcium Chloride", by Fred Burggraf, Research Engineer, Calcium Chloride Association, Detroit, Mich. Copies of this bulletin may be obtained, without charge, from the Calcium Chloride Association, 4145 Penobscot Bldg., Detroit, Mich.

Vibrating Screens—A new bulletin illustrating and describing its Cedar Rapids Symons screens has just been issued by the Iowa Manufacturing Co., Cedar Rapids, Ia. It tells the complete story of these screens. Bulletin S.S. 1 is yours for the asking.

Snow Plows—A new Good Roads snow plow catalog is now ready for distribution by the Good Roads Machinery Corporation, Kennett Square, Pa. This is an attractive 68 page book, fully illustrating and describing the many types and models of Good Roads Champion snow plows, together with their distinctive features and various attachments. Write for your copy of Catalog No. 102.

Portable Compressors—A 24 page catalog entitled "Sullivan Plus Portable Compressors" is just off the press. Profusely illustrated, it fully describes the complete line of two stage portable air compressors manufactured by the Sullivan Machinery Co. and contains specifications and data of value to those concerned with application of air compressors and air tools to construction and maintenance work. Copies may be had from the Sullivan Machinery Co. at Woodland Ave., Michigan City, Ind.

Reflector Buttons—A new catalog of its button reflector highway warning signals has been issued by the Federal Stamping and Engineering Corporation, 15 Lafayette St., Brooklyn, N. Y. Various combinations of the buttons and installations for particular purposes are illustrated in colors.

Handbook on Timber Construction—The Southern Pine Association has issued the 13th edition of its Standard Handbook on Timber Construction. This handbook, which has been the recognized data book on timber design for more than 25 years, has been popular with architects and engineers because of the complete manner in which it covers timber construction and also because of its handy, compact size. The new edition contains a number of additions to the former issues, including an explanation and all necessary working data on timber connectors, the modern efficient way of making a timber joint, on built-up columns, and on design of timbers where sheer stresses govern. Changes also have been made in many of the tables included in former editions, so that they more effectively meet the requirements of designers. Besides information and data on all forms of lumber construction from joists, studs and sheathing to heavy timber structures this manual contains mathematical tables and formulae and data on steel members. Included also are data on nails and bolts for designing purposes, a chart showing the standard grades of structural timber for designs based on stress designations of the American Railway Engineering Association, American Society for Testing Materials and American Association of State Highway Officials. The price of the manual has been reduced from $1.50 to $1.00 per copy. It is available from the Southern Pine Association, New Orleans, La.

Bituminous Pressure Distributor—The mechanical advantages of its new Model "TS" distributors are described in a bulletin just issued by Littleford Bros., 454 East Pearl St., Cincinnati. Various features of distributor are illustrated and described and specifications on standard equipment are given. Write for Bulletin M-17.

Crushing Plants—The Austin-Western Road Machinery Co., Aurora, Ill., has issued a new bulletin on its C.E.P. crushing plants. The plants are illustrated and described and their specifications are given. Bulletin 1702 is yours for the asking.

Tractors—Two interesting booklets have been issued recently by the Cleveland Tractor Co., Cleveland, O. One, is a 28 page publication covering the Cletrac "AG" streamlined tractor. Every feature of the tractor is explained and illustrated. Large, sectional views slice the tractor open for inspection. The other booklet "Around the World With Cletrac Crawler Tractors" shows Cletracs in hundreds of operations in the United States and in many corners of the world. Your copies of these booklets can be obtained by writing to the company.

Merchandise Your Road Show Exhibit in the December and January issues of ROADS & STREETS

CLEARING HOUSE

ADVERTISERS' INDEX

The Dash (—) Indicates that the Advertisement Does Not Appear in This Issue

***Advertisers with * are represented in the 1937 edition of Powers' Road and Street Catalog and Data Book. Please refer to it for additional information on any of their products.**

METAL CULVERTS *have high drainage capacity. They are quickly and easily installed. No special, heavy equipment is required . . . more reason to use these economical, long-lasting drainage structures.*

WHEN you install metal culverts you get strength . . . endurance . . . high drainage capacity . . . rapid installation . . . elimination of repair costs . . . greater salvage value. These factors make metal culverts the most durable, practical and economical drainage structures.

By specifying culverts fabricated from USS Copper Steel Galvanized Sheets you protect your investments in materials and installation costs. USS Copper Steel has the strength to support heavy loads and metallurgical characteristics which time and experience have proven to be the best for durable culvert materials.

In USS Copper Steel Galvanized Sheets the firm base of time-resisting copper steel is given added protection against corrosion by a tightly adhering heavy coating of commercially pure zinc — applied by the hot-dip process. The precision of methods employed in this process further lengthens the life of culverts fabricated from these strong, carefully-formed sheets.

Metal culverts have very definite advantages. To be sure that you get all of them, specify that your culverts be fabricated from USS Copper Steel Galvanized Sheets.

U·S·S COPPER STEEL GALVANIZED SHEETS

CARNEGIE-ILLINOIS STEEL CORPORATION · *Pittsburgh and Chicago*
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UNITED STATES STEEL

ROADS and STREETS

With which have been merged GOOD ROADS and ENGINEERING & CONTRACTING

Published Monthly by
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THIS MAGAZINE IS DEVOTED TO
Design, Construction and Maintenance of Highways, Streets, Bridges and Grade Separations

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Chicago Office
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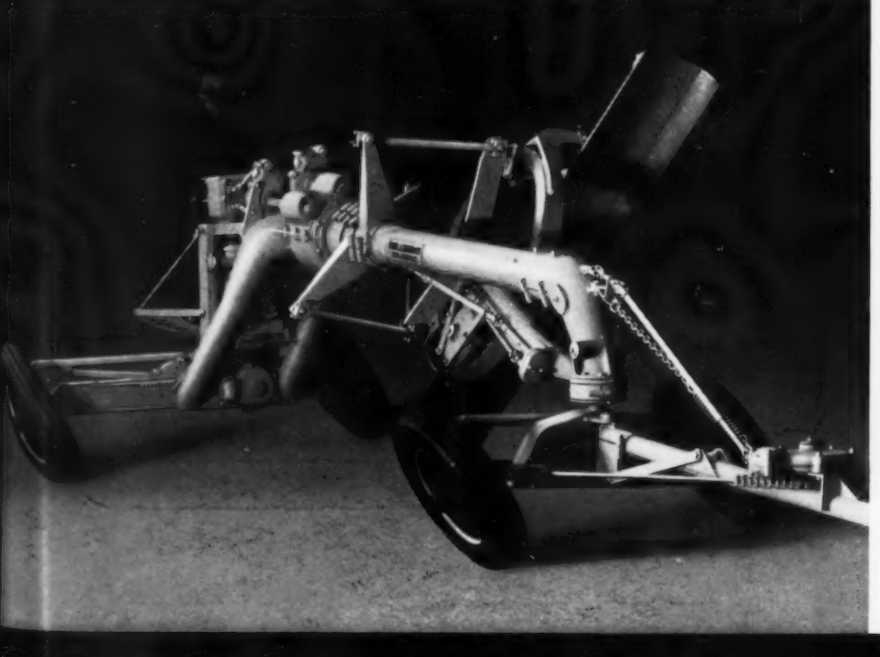
Vol. 80 | DECEMBER, 1937 | No. 12

CONTENTS

WARCOS *for* DEPENDABILITY STABILITY AND LOW-COST OPERATION



WHEN WARCO Motor Graders were first produced, more than fifteen years ago, they were noted for their outstanding Stability, Performance and Economy.

Today WARCO Equipment possesses not only all of these merits, but offers you the latest in Modern Design and Construction as well.

See these Up-to-the-Minute Motor and Blade Graders at the Cleveland Road Show, January 17 to 21. Space C-34.

THESE THREE SHOW THE WAY TO PROFIT

- Model "33" Rear Controlled, Power Controlled; with Tandem Drive; powered with either Gasoline or Diesel. A Modern Machine for Modern Highways.

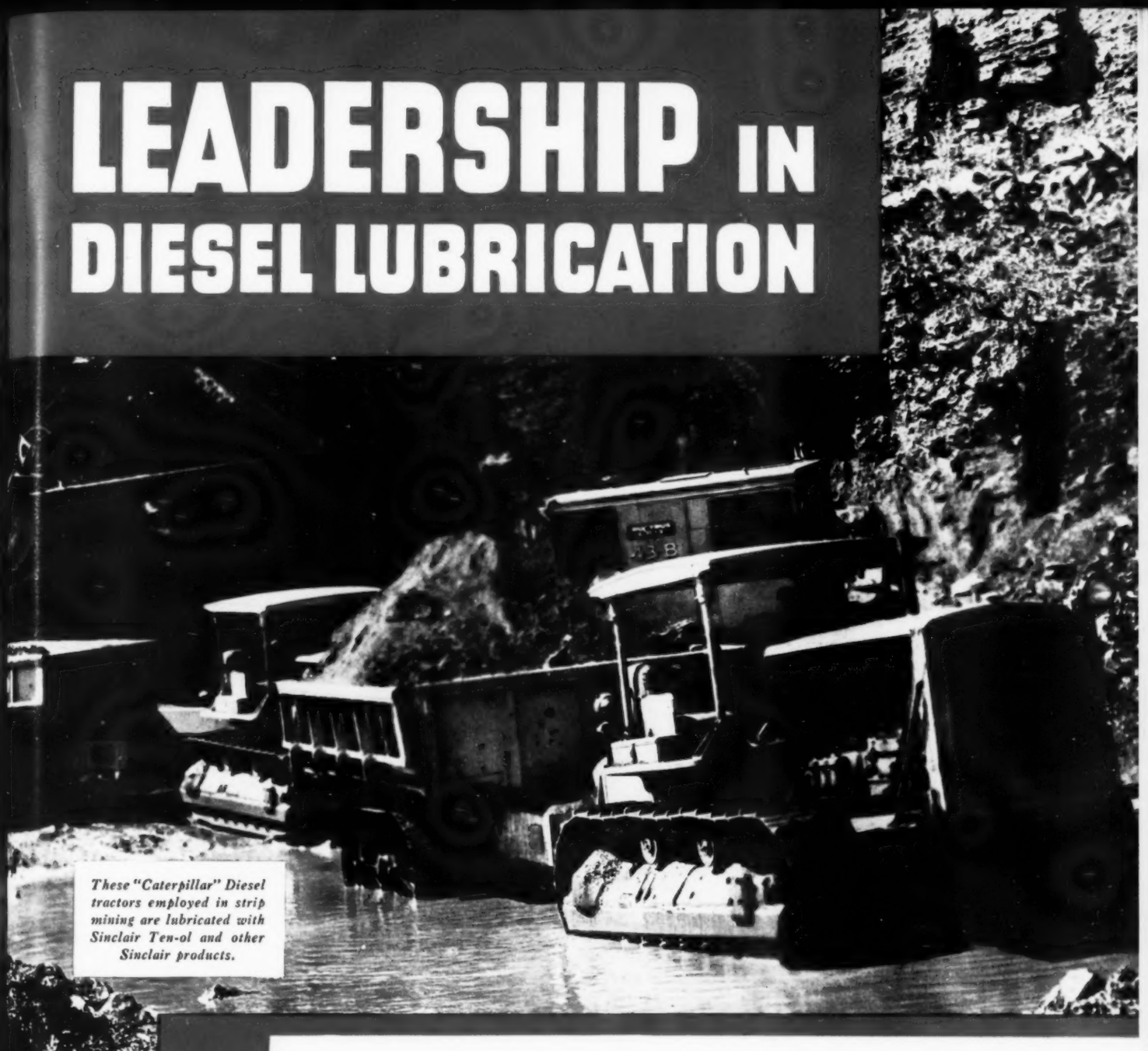
- Model "H" Center Controlled; with Octopus 8-Wheel Drive; also powered with either Gasoline or Diesel Engine. A Mighty Machine for Construction Work.

- The New WARCO Power Controlled, Tubular Frame, High Lift, Leaning Wheel, Heavy Duty Blade Grader.

W. A. RIDDELL CORPORATION
SUCCESSOR TO W. A. RIDDELL CO.–HADFIELD-PENFIELD STEEL CO.
AMERICAN CLAY MACHINERY CO.

BUCYRUS
OHIO

LEADERSHIP IN DIESEL LUBRICATION



These "Caterpillar" Diesel tractors employed in strip mining are lubricated with Sinclair Ten-ol and other Sinclair products.

SINCLAIR TEN-OL

REG. U. S. PAT. OFF.

Less than a year ago Sinclair introduced Ten-ol, a lubricant as rugged in service performance as the "Caterpillar" Diesel engines for which it was developed.

Wide acceptance put Ten-ol to the most convincing of tests—showdown of performance under the toughest operating conditions. For example, in mining and quarrying... in road building ... on public projects.

"Caterpillar" Diesel operators find Ten-ol increasing service hours, giving sustained top-notch engine performance, and providing full lubricating protection under emergency overloads. That's why it is recommended as a "new, outstanding Diesel engine lubricant" by Caterpillar Tractor Co.

Try Sinclair Ten-ol and Sinclair Diesel fuel. Order them and other Sinclair products from your local Sinclair office, or write Sinclair Refining Company (Inc.), 630 Fifth Avenue, New York, N. Y.

SINCLAIR TEN-OL

is recommended as a "new outstanding Diesel engine lubricant" by Caterpillar Tractor Co.

PROOF

that you can get better performance and cut costs with "RPM" DIESEL ENGINE LUBRICATING OIL

CALIFORNIA

"Been using 'RPM' Diesel Engine Lubricating Oil in three 'Caterpillar' Diesels for six months . . . over 3,000 hours each. No increase in consumption . . . no loss of time . . . efficiency of 'RPM' *will cut my operating costs in half!*"

E. C. Salyer, Farming Contractor, Corcoran, California

WASHINGTON

"'RPM' Diesel Engine Lubricating Oil loosened and cleaned out old carbon . . . and we are now pulling the same load at one notch lower on the throttle."

VIRGINIA

"From the standpoint of performance and reduction in service costs, 'RPM' Diesel Engine Lubricating Oil is superior to anything we have been able to use in 'Caterpillar' Diesels."

R. H. Carter, Virginia Tractor Co., Inc., Richmond, Virginia

ALASKA

"The finest oil that I have ever used in a 'Caterpillar' Engine."

CANADA

"Hauling about 300 tons to the train — compression and power after 1,500 hours of severe winter work as good as the day we got the 'Caterpillar' Diesel."

TENNESSEE

"'RPM' Diesel Engine Lubricating Oil has relieved us of considerable expense and at the same time has added many hours of engine life to 'Caterpillar' Diesel Engines!"

John Fabick, Jr., Fabick Tractor Co., Memphis, Tennessee

LOOK FOR THIS TRADE MARK

RPM

REG. TRADE-MARK

DIESEL ENGINE LUBRICATING OIL

Caution: There is only one Diesel engine lubricating oil identified by the "RPM" trade-mark.

DAY after day come letters from everywhere — acclaiming "RPM" Diesel Engine Lubricating Oil! It's proof that patented super-active "RPM" Diesel Engine Lubricating Oil will keep your "Caterpillar" Diesel Engine at its peak efficiency throughout a heavy, strenuous season.

It's proof that the bugbears of carbonization, sludge and excessive overhauls for carbon removal have been licked.

Test it for yourself. Insist on the *patented* lubricant identified by the "RPM" trade-mark. Recommended by Caterpillar Tractor Co. — and by Diesel engine operators in all corners of the globe.

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DRIVES AND STEERS ON *all 4 Wheels*

"worth any two similar machines I ever saw work on this kind of job." A Bureau of Public Roads Engineer.

"does a better job two or three times quicker," says an operator.

A State Highway Dept. Engineer says *"we should put a machine like this in every district."*

In January a New Machine Will Be Offered by Austin-Western

★ **On display at the Cleveland Road Show, January 17th-21st**

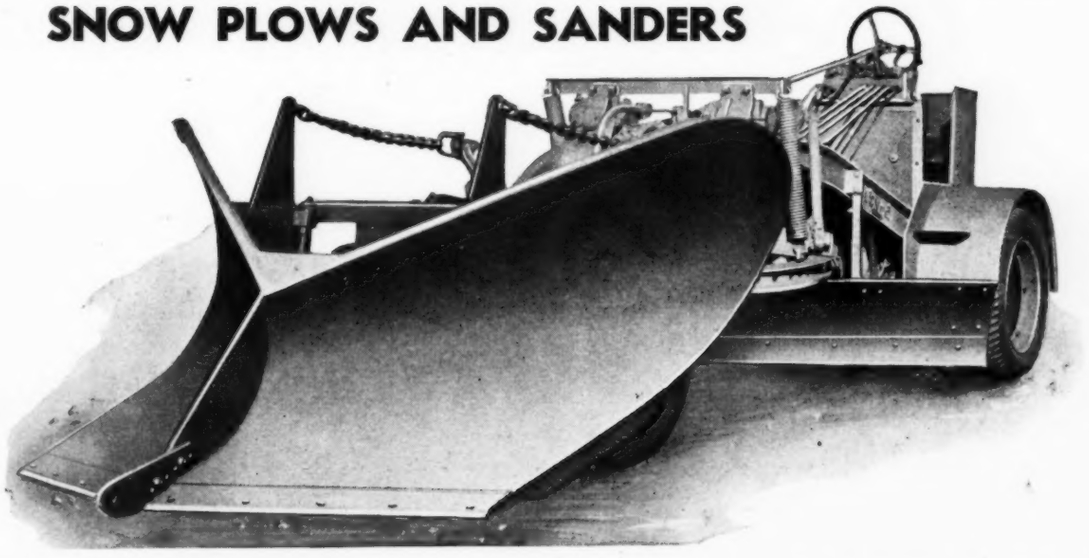
THE AUSTIN-WESTERN ROAD MACHINERY CO.
Aurora, Illinois

99MG797

Austin-Western

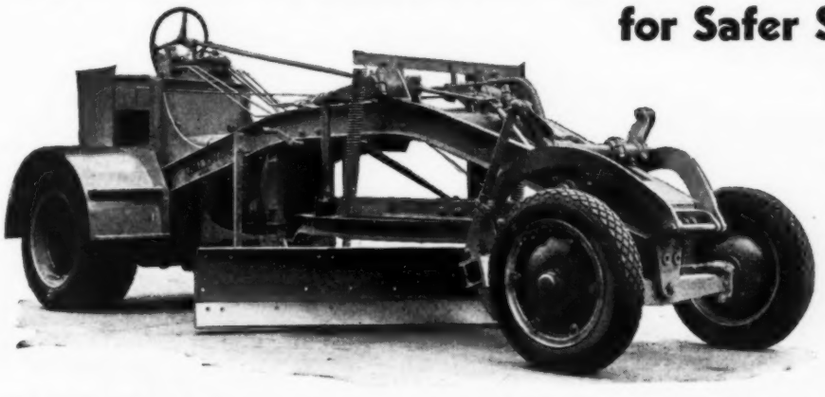
GALION

SNOW PLOWS AND SANDERS



for EFFICIENT SNOW REMOVAL

for Safer Streets and Highways



The Galion "Junior Patrol" motor grader equipped with snow-plow attachment is shown at the top. Next above is illustrated the same unit without the plow, while below is shown the Galion highway sander spreading sand on an icy highway.

To give the "ALL'S CLEAR" sign so that traffic can go on this winter, you must first remove that accumulation of snow. One of the most efficient and economical means of doing this is made available by the Galion combination . . the Junior Patrol motor grader and the sturdy snow-plow attachment (shown above).

•

The snow-plow attachment is available for all makes of Galion graders. When not in use for snow-plowing or ice-removal, the Galion Junior Patrol is an ideal unit for general road building and maintenance work.

•

After the snow has been removed, you can make those icy roads and streets safe for traffic by spreading sand, cinders, stone dust, chips or Calcium Chloride on them. The Galion highway sander (left-below) is an inexpensive tool that will do the job quickly and at low cost. *You can reduce* the growing number of highway fatalities with the Galion sander. Send for more details.

•

Take advantage of Galion's experience in building road machinery of all kinds. You will find that we know how to provide for reliability under tough conditions, for the most in service and economy, and low investment. Write today.

GALION ROAD MACHINERY points to better roads

The Galion Iron Works & Mfg. Co.

HEAD OFFICE AND WORKS — **EXPORT DIVISION**

Galion Ohio — **Columbus Ohio**

INTERNATIONAL DISTRIBUTION

Every County can afford THIS METHOD OF ROAD IMPROVEMENT with STANDARD ROAD OIL

FOUR SIMPLE STEPS

1 The road is scarified for the width of the surface desired.

2 The surface is immediately bladed and rolled to break up the lumps and compact the surface.

3 Standard Asphaltic Road Oil is applied hot with a pressure distributor.

4 In some cases the road is barricaded for a short time to allow the oil to penetrate. Above is a typical Scott County, Iowa, road built up to a fine bituminous mat that may be traveled safely in all weather, the year around.

● The problem of providing adequate farm-to-market highways on a limited road fund has been solved in many counties by the simple method of road treatment described here.

Like many others, Scott County, Iowa, utilizes the present road material without any additional aggregate. This can be mixed with Standard Asphalt Road Oil on the road.

By providing a method of yearly development this plan eliminates high initial investments and interest payments. Within a few short years, roads so treated develop a heavy bituminous mat that can be maintained with the minimum of expense and *all* at a yearly cost that any county can afford.

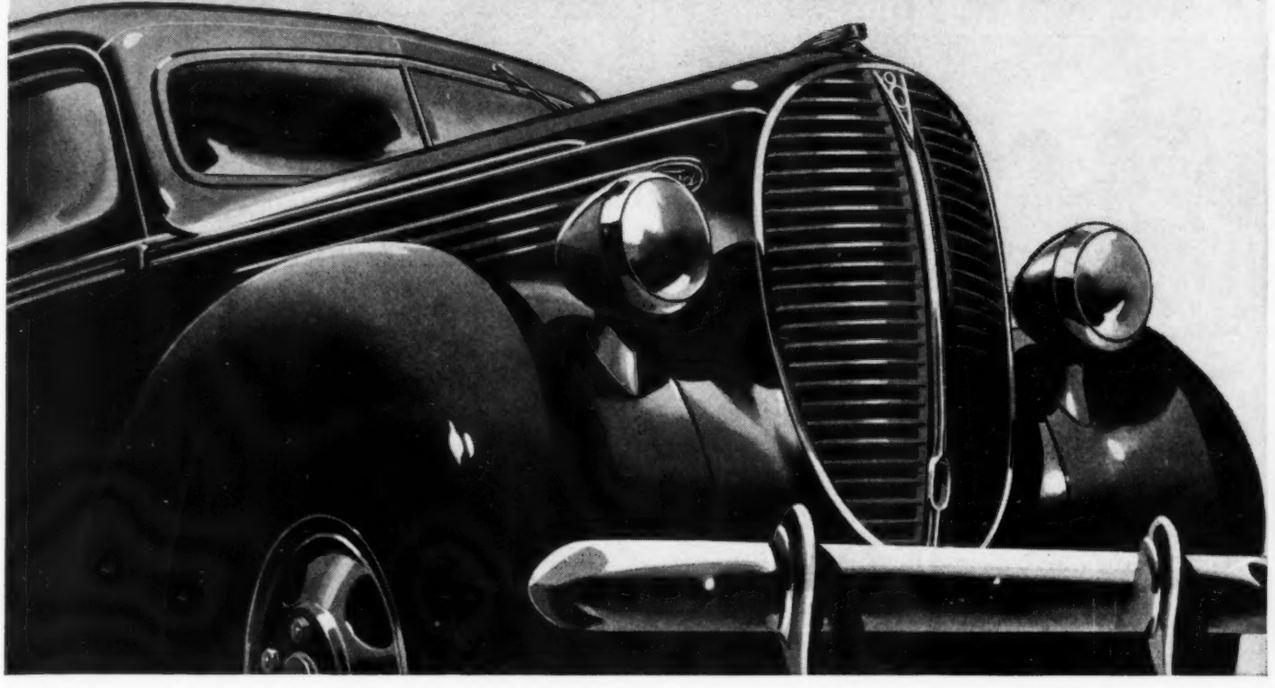
A Standard Asphalt representative can give you complete specifications and costs on Standard Road Oil construction. Communicate with the local Standard Oil office or write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

Asphalt for every purpose

STANDARD OIL COMPANY
(INDIANA)

ANNOUNCING THE 1938 LINE OF FORD V-8 TRUCKS

INCLUDING A NEW One-Tonner



FORD OFFERS WIDE RANGE. FAMOUS V-8 ENGINE BRINGS NEW ECONOMY TO LOADS IN ONE-TON RANGE

THE Ford Motor Company has built more than four million trucks. With this great background of experience, it means something to say that the 1938 Ford V-8 Trucks are the finest Ford has ever built.

Here is the widest range of types and sizes in all Ford history. The big 134-inch and 157-inch wheelbase Ford V-8 Trucks are designed to do the work of heavier, more expensive units—and do it faster, at lower cost. An entirely new line of 122-inch wheelbase one-ton trucks has been added to bridge the gap between the larger trucks and the new 112-inch wheelbase commercial cars. For practically every hauling and delivery requirement there is now a unit that gives the high Ford standard of dependability and economy!

The 1938 line of trucks and commercial cars are all newly styled. They have an impressive new front end, a sturdy new grille, new headlamps, massive full-skirted fenders. Their smart, modern appearance is a definite asset to any business.

Other important advances for 1938 are a new 134-inch wheelbase in the big truck line . . . a new frame width for both the 134-inch and 157-inch wheelbase units . . . 7.50—20 dual tire and wheel equipment available at extra cost . . . improved brakes and easier steering . . . stronger construction in vital parts.

The new one-tonners and the commercial cars offer a choice of the 85 or 60 horsepower V-8 engine.

Your Ford dealer invites you to see the new line—and to make an "on-the-job" test with your loads and your driver.

LOW FIRST COST IS ONLY THE START OF FORD ECONOMY

FORD'S SEVENTH YEAR OF V-8 SUCCESS

Do You Know That--

IN ADDITION TO ITS CLAIM OF HAVING FRAMED A DECLARATION OF INDEPENDENCE" ANTEDATING BY MORE THAN A YEAR THE ONE DRAWN UP JULY 4, 1776, MECKLENBERG COUNTY, NORTH CAROLINA, APPEARS TO HAVE BEEN FIRST TO SUCCESSFULLY ORGANIZE EFFORTS AIMED AT GETTING AWAY FROM THE PRACTICE OF RESTING SOLE RESPONSIBILITY FOR THE CONDITION OF PUBLIC RIGHTS-OF-WAY ON THE OWNER OF PROPERTY ABUTTING ON THE ROAD. A MECKLENBERG LAW OF 1879 MAKING POSSIBLE BROADER COOPERATION, THE USE OF CONVICT LABOR, ETC., EARNED FOR THAT COUNTY THE TITLE, "CRADLE OF HIGHWAY WORK IN AMERICA."

ONE OF THE WORLD'S TOUGHEST JOBS WHERE THE *All-Wheel-Drive* HAS ITS GREATEST VALUE

SNOW REMOVAL

SNOW, snow, and more snow! As sure as death and taxes, it comes year after year, and highway crews must fight relentlessly to keep the roads open.

The situation is here, Now. If your snow-removal equipment is not adequate, MARMON-HERRINGTON will exert every effort to help you meet the emergency with prompt delivery. Give your crews the equipment they need. Big, powerful MARMON-HERRINGTON *all-wheel-drive* trucks that have "pull as well as push," and *tractive ability* to keep going over packed snow, ice and sleet.

This year more generally than ever before, MARMON-HERRINGTON *all-wheel-drive* trucks are making the snow fly on countless highways throughout the world. Equipped with most modern snow-removal plows, their superior traction is knocking hours off snow clearing schedules. Their extraordinary power to "hit the drifts" on clogged mountain passes is cutting highway maintenance costs to the minimum.

MARMON-HERRINGTON builds *all-wheel-drive* trucks in all sizes and capacities, from converted Ford V-8's with permissible loads of 8,400 to 22,000 lbs., to mammoth units in the regular MARMON-HERRINGTON line up to 50,000 lbs. capacity, and ability to operate the biggest motor-driven rotary plows. All over the world these great *all-wheel-drive* trucks are tackling, and *licking* the jobs that "couldn't be done."

Get the facts about MARMON-HERRINGTON *all-wheel-drive* trucks for snow-removal and general highway maintenance. They are safe, dependable, and will *save money in first cost, as well as in operation.* See your nearest Marmon-Herrington dealer—or write or wire MARMON-HERRINGTON at Indianapolis for full particulars.

MARMON-HERRINGTON CO., INC., Factory and General Offices: INDIANAPOLIS, IND.

★ *World's Leading All-Wheel-Drive Engineers and Manufacturers* ★

MARMON-HERRINGTON ALL-WHEEL-DRIVE TRUCKS

90% OF YOUR TRACTOR WORK IS DONE AT THE HIGHER SPEEDS . . . BUY TRACTORS THAT *Excel* ON THIS 90%

Allis-Chalmers tractors are designed to deliver maximum performance at the higher working speeds. These are the speeds at which you do 90% of your tractor work on the average construction job. Buy tractors for this 90% of your work . . . not for the other 10%.

ABOVE—Building spur line for railroad near Canton, Ill. In the foreground are two Model "S-O" Oil Tractors pulling Continental Scrapers on tracks. *BELOW*—Model "S-O" Tractors and 7-yard Continental Scrapers on road building jobs in Illinois and Wisconsin.

Let's Go! Road Show, Jan. 17-21, Cleveland, Ohio.

ONHE GO"—haul more loads per day

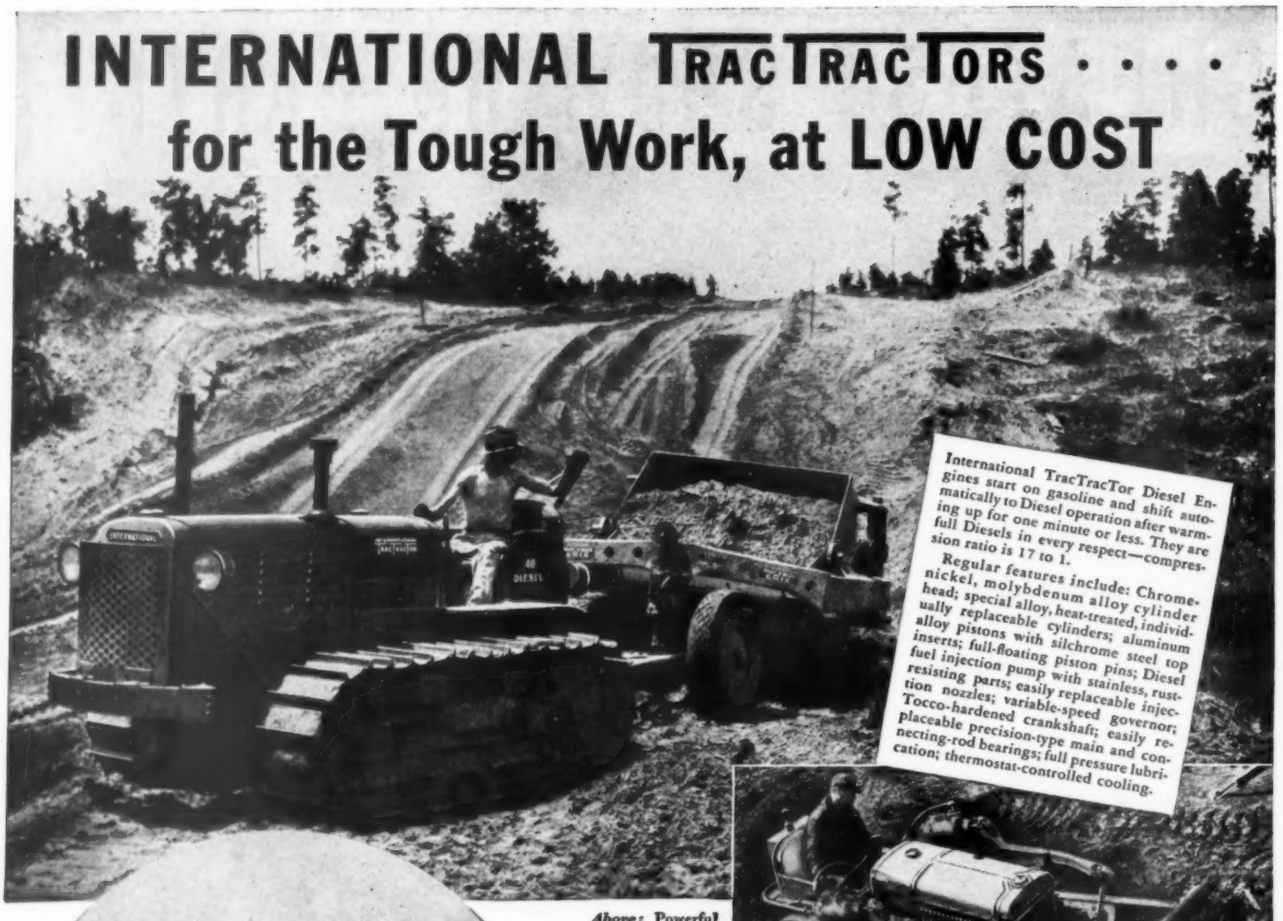
The seconds you save shifting gears with an Allis-Chalmers Model "S-O" ... count up into minutes in the course of a day. These minutes mean more trips, more yardage, more profit for the Allis-Chalmers owner. With the "S-O", it is not necessary to come to a complete stop to shift gears. You shift "on the go"—like a motor truck. Only the Allis-Chalmers Model "S-O" has this time-saving feature ... a Constant Mesh Transmission with gears always in mesh. Only the Model "S-O" in its power class (64 drawbar H.P.) has 5 speeds forward—up to 6.37 miles per hour. In its size and price class, only the "S-O" has that famous Allis-Chalmers BALANCE ... which means quicker pick-up, higher working speeds, better hill-climbing, greater economy, less maintenance and superior all-'round performance. Only the "S-O" is built to BEAT the job—not stretched to meet it. Put the "S-O" to work on your job! It's the MODERN tractor for modern requirements. Ask the A-C Dealer!

ACTOR WEIGHT SAVED MEANS EXTRA PAYLOAD GAINED

ALLIS-CHALMERS
TRACTOR DIVISION—MILWAUKEE, U. S. A.

Controlled Ignition **OIL TRACTORS**
Timed Right to Fire at the Right Time

INTERNATIONAL TRACTRACTORS . . . . for the Tough Work, at LOW COST



International TracTracTor Diesel Engines start on gasoline and shift automatically to Diesel operation after warming up for one minute or less. They are full Diesels in every respect—compression ratio is 17 to 1.

Regular features include: Chrome-nickel, molybdenum alloy cylinder head; special alloy, heat-treated, individually replaceable cylinders; aluminum alloy pistons with silchrome steel top inserts; full-floating piston pins; Diesel fuel injection pump with stainless, rust-resisting parts; easily replaceable injection nozzles; variable-speed governor; Tocco-hardened crankshaft; easily replaceable precision-type main and connecting-rod bearings; full pressure lubrication; thermostat-controlled cooling.

The International T-20 TracTracTor equipped with bullgrader. Shown on excavation work, a job for which this compact outfit is ideally suited.

Above: **Powerful International TD-40 Diesel TracTracTor operating a 4-wheel scraper. A popular combination on dirt-moving jobs everywhere.**

MODEL TD-35 DIESEL TRACTRACTOR

The popular features of International Diesel design are now available in the new International TD-35—a smaller Diesel TracTracTor at a lower price. Complete information supplied on request.

INTERNATIONAL TRACTRACTOR design, quality, performance, and economy offer the answer to your power problem. Make a thorough study of the TracTracTors — there are five models, to fit your needs exactly. Ask for a demonstration. The International line also includes a wide variety of wheel-type industrial tractors, and power units in sizes up to 110 max. h. p. The nearest International Industrial Power dealer or Company-owned branch will give you complete information on any tractor or power unit in the line.

INTERNATIONAL HARVESTER COMPANY
Harvester Building (INCORPORATED) **Chicago, Illinois**

INTERNATIONAL HARVESTER *Quality* PRODUCTS

INTERNATIONAL Industrial Power